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FIELD INTRENCHING: ITS APPLICATION ON THE BATTLE-FIELD AND ITS BEARING ON TACTICS.

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"Virtus in actione consistit."

THE objects which the writer of the present Essay has had principally in view are:—

1stly. To examine the course which Tactics have taken in modern times under the influence of improvements in weapons, &c., and

2ndly. To endeavour to discover the principles which should govern Tactics in the future, having regard to the experience recently gained.

In pursuing these objects the subject of *Field Intrenchments* will naturally occupy a prominent position.

In order to carry out the writer's plan it will first be necessary to review the operations of recent wars and try to obtain from the mass of facts recorded an abstract in concentrated form of the salient features of the fighting in each campaign, of the conditions under which success or failure ensued, and of any principles which appear to be of general application.

From the materials so obtained, the attempt will then be made to lay down some general lines for the conduct of Tactics in the future; and by this course it is hoped that the greatest safeguards may be afforded against the danger of being led away by theory to results not to be warranted by experience.

The first war it appears necessary to examine is that between the Northern and Southern States of America. This war was fought under very peculiar conditions as regards the circumstances of the combatants, the composition of the armies, and the nature of the country;

and the ultimate result depended rather upon the greatly superior resources of one of the combatants and the exhaustion of the other, than upon tactical successes. We cannot therefore expect to find the experiences of it always such as we can make use of for deducing general principles, but there are nevertheless a great many points in it worth noticing, from which instruction may be gained.

In this war a very great use was made of intrenchments. The first reason for this was to guard against surprise. The thickly wooded nature of the country rendered it difficult to keep a close watch upon the enemy's movements, and defensive works were therefore employed to enable troops suddenly attacked to hold their ground. A belt of wood was cut down to give a certain amount of clear view, the trunks of the trees were formed into abatis or entanglements, and breastworks were thrown up on the inner margin of the cleared space. In this way the enemy was delayed long enough to enable the troops to get under arms and into their positions before the assailants were actually in their midst.

At the battle of Shiloh, in April, 1862, on the first day, General Grant's force not being intrenched was surprised by the Confederates and severely defeated, though reinforcements arrived before the following day and partly retrieved the disaster. After this, when the Federals advanced from Shiloh to Corinth, Colonel Fletcher tells us: "With great caution did the army advance; each successive camp "was fortified, and careful lines of defence, quickly constructed with "the spade and axe, covered the front and prevented a repetition of a "surprise of the pickets, as on the first day's battle of Shiloh."[1] General Sherman, who commanded a Division at this time, in an address to his Division of the 31st May dated Corinth, congratulates it, "on its industry in strongly intrenching seven distinct camps "since its march from the camp at Shiloh," the distance from Shiloh to Corinth being about 25 miles. A correspondent, writing from General Pope's Division, says:—

"One curious feature of the advance now is, that of throwing works of defence "up along the whole line. The fortifications completed to-day cannot be less than "12 miles in length, extending from the extreme right to the extreme left wing. "They are strongly made with logs and earth, lined by rifle-pits, and distant from "Corinth six miles. Every movement is characterised by extreme caution. To-"morrow the line advances four miles, when another parallel will be constructed. "In case any reverse should happen, these defences would be invaluable."[2]

In these operations the Federal army was composed of raw and inexperienced troops with inferior discipline, and the Confederates were credited with superior aptitude for fighting and with the wish to take advantage of this superiority. Therefore the Federal General (Halleck) believed it necessary to act with extreme caution and prepare in every way to resist offensive operations on the part of the enemy, although himself considerably superior in point of numbers, But the result was extreme slowness of movement, it took him six weeks to advance less than fifteen miles, and when at last he arrived

[1] Fletcher, "History of American War," vol. ii, p. 35 *et seq.*
[2] Fletcher, vol. ii, p. 36, note.

before Corinth and prepared to assault the Confederate position, which had meanwhile been strongly intrenched, he discovered that he had been outwitted, the Confederate army had flown, leaving nothing but wooden guns and barren defences as his prize. His slowness and failure to reap any advantage from his commanding superiority in strength has been severely criticized by some of those serving under him.[1]

The first cause that led to the extensive employment of intrenchments in this war was therefore the close nature of the country, which rendered some protection against surprise and sudden attacks a necessity. But it was also very quickly recognised what additional strength was given by intrenchments to a position. Innumerable instances occurred in which intrenchments played a prominent part in battles, and it will be well to glance at a few cases which seem to be of typical importance.

When McClellan advanced on Richmond in 1862 his army threw up intrenchments along the Chickahominy. On the 26th of June the Confederates attacked the right of the Federal line. Under the eyes of General Lee himself two brigades "descended the right bank of "Beaver Dam Creek, they even essayed to cross the stream, although "the waters were waist-high; they were within 100 yards of the "enemy's batteries; but even those brave troops could not stand "against the storm of shot, shell, canister and rifle bullets, which was "poured upon them from the breastworks crowning the left bank." Here the attacking troops were most impetuous, brave, and determined, but the defenders were well sheltered, had an open slope down to the stream for a field of fire, and had suffered little from artillery, which could not be much used on account of the thick woods through which the assailants advanced to the stream. So the attack entirely failed.

An incident, worthy of being carefully noted, occurred after the second battle of Bull Run, in August, 1862. The defeated Federals occupied a line of field works near Centreville. Lee, with inferior numbers and weary troops, did not wish to hazard a direct attack on an enemy who had been reinforced, and was occupying so strong a position; but sent D. Hill's corps round the right of the Federals to threaten their communications with Washington. Then General Pope, *unable to give battle on account of the demoralization of his troops*, retreated.

Observe in this incident that the Federals, though superior in numbers, were inferior in quality; but their works gave them so much strength that Lee dared not attack them, but their position could be turned. Lee considered it safe to attempt to turn it, knowing his troops to be superior in the open, and the Federal leader, equally conscious of this fact, had no alternative but retreat. Thus we see here intrenchments held by inferior troops, proof against direct attack, but when the position can be turned, losing their efficacy in the face of troops of superior quality, and of skilful and bold generalship.

The campaign of Chancellorsville is also instructive. General

[1] Badeau, "Military History of U. S. Grant," vol. i, pp. 101 *et seq.*

Hooker, with the Federal army, crossed the Rappahannock, and occupied a position strengthened by earthworks and abatis, hoping that Lee would attack him on his own ground; but Lee, feinting with two divisions in his front, sent Jackson with three divisions to turn his right flank. Jackson's movement began during the night of the 1st May, 1863; and at 4 P.M. on the 3rd, he fell suddenly on Howard's corps unintrenched and utterly unprepared for an attack. This corps was routed, and serious disaster might have followed to the whole Federal army, had not Jackson been killed. The next day Lee, taking advantage of the discomfiture of the enemy and the high spirit of his own men, attacked the Federals in front and drove them from their intrenchments to a second line behind Chancellorsville. There Hooker remained inactive, while Lee defeated Sedgwick, who was advancing on his flank and rear from Fredericksburg, and then retired again across the Rappahannock.

We here see an army, superior in numbers, defeated in spite of its intrenchments, through its flank being turned; but the flank movement occupied two days, and would have been very dangerous if the Federals had discovered it and acted boldly by attacking either Lee or Jackson whilst separated. The movement was successful on account of the thick country hiding what was going on, and on account of the bad arrangement of the Federals, who had no outposts or patrols; and further on account of the known inferiority of the Northern troops and General, which enabled Lee to calculate on carrying out his plans. Superior generalship and quality of troops again told, for Lee knew what he could risk and did not hesitate to do it, and the event proved the correctness of his calculations. Hooker with his vast army dared not move, knowing his own weak points and the skill and activity of his enemy, so that he first had his flank turned, next was actually beaten by a front attack on his intrenchments, through the demoralization of his men; and finally was obliged to remain inactive whilst his lieutenant was being defeated, instead of co-operating with him and crushing Lee's little army between them.

Observe that close country favours the most mobile army.

In the battles of Gettysburg, 2nd and 3rd July, 1863, we find the Confederates defeated in spite of all Lee's skill and his soldiers' bravery, in a front attack on a strong intrenched position. General Meade had placed his army on a range of heights in a convex form, strong with walls, hedges, woods, &c., while the Confererates attacked from an exterior arc. Hence the Federals could easily reinforce critical points, while the Confederate attacks were disjointed and inefficiently supported. The Federal troops also had improved in quality. In this case strategical and political reasons forced Lee to fight in spite of the risk and difficulty of attacking a selected and strong position, but there appears to have been a want of plan in the attack; the several assaults were delivered apparently at random, and there was seemingly no selection of any one as the principal attack, and no concentration of effort on the decisive point.

In the battle of Missionary Ridge, 25th November, 1863, we find some want of skill in the arrangement of their defensive works on the

part of the Confederates. They had thrown up batteries near the foot of their ridge, but had provided no shelter for horses, so the horses and waggons were placed behind the crest of the ridge. From this arrangement it followed that the men bringing up ammunition were much exposed, and the guns could not easily be got away in case of a reverse.

During the battle, General Sherman attacked the Confederate right by getting on the ridge occupied by them beyond their flank and moving along it, but he could not get within 80 yards of the intrenchments the Confederates had thrown up across the ridge, and his attack was checked. Bragg, however, the Confederate General, weakened other parts of his line, which was very extensive for his numbers, to meet this flank attack, and when the Federals attacked his centre, they drove his men from their lower intrenchments, and without stopping, swept up to the crest, the rapidity of their advance saving them from severe loss, many shots aimed at them going over their heads. Thus the centre of the Confederates was broken and the battle lost to them.

Here we are brought in contact with a difficulty the defence has often to deal with, viz., the impulse to stretch the line unduly with regard to the number of troops available, so as to cover a certain object or render turning operations more difficult; but if the assailant is superior, he can spare troops for a wide turning movement, to meet which, some part of the front is pretty sure to be dangerously weakened, thus affording a *chance* of success at all events to a front attack.

This battle illustrates also a danger incident to positions on high and steep ridges. If the crest alone is occupied there will generally be large spaces but poorly swept by fire, and the assailants will be able to approach very near the main position without suffering serious loss. If, on the other hand, troops are placed low down on the slopes, they are apt not to hold their ground very firmly on account of the fear of having their retreat to the ridge endangered, and when they fall back the assailants may follow them up to the ridge in comparative safety, as they will be masked to a great extent by the fugitives; and shots, moreover, fired down a steep slope are apt to go over the object aimed at, as was the case at Missionary Ridge. The battle of Spicheren affords another instance of weakness due to high and steep ground. The French did not occupy the lower edge of the woods on the steep slopes on their right flank, and the Germans were able to press up to the top of the slope before encountering serious resistance or loss.

In the Wilderness campaign in 1864, we find the Confederates gradually getting hemmed in and exhausted, by the superior resources and strength of the Northern States; but the genius of Lee and the devotion of his troops kept the Northerners at bay for a long time yet, and the lines round Petersburg and Richmond were as hard a nut for Grant to crack as were those round Plevna for the Russians.

The Atlanta campaign between the Federals, under Sherman, and the Confederates, under Joe Johnston, affords some remarkable examples of the employment of intrenchments and of the strategy

thereby called into play. Johnston retreated before Sherman across the Etowah river, south of which was a strong position in the hills about Allatoona, traversed by the railway. This position Johnston occupied. Sherman considered this position too strong to attack, and he therefore made arrangements to turn it. On the 23rd May, he crossed the Etowah and marched on Dallas, with the object of turning the mountains in the vicinity of Allatoona, and avoiding attacking the enemy in the pass through which ran the railway. Johnston divined his adversary's object, gave up Allatoona, and moved in a corresponding way to Sherman, so as to continue to cover Marietta, and on the 25th, Hooker's corps of Sherman's army came upon Hood's corps of Johnston's army, strongly intrenched across its road at New Hope.

Then followed a series of remarkable operations, each army throwing up intrenchments and manœuvring to outflank or find a weak point in its adversary's lines. Sherman gradually extended his left to reach the railway on the south side of the Allatoona Pass, while Johnston followed his movements, watching for a chance of attacking him successfully if he weakened any part of his line too much in extending it. Once he thought he saw his opportunity and attacked, but the Federals were found well protected by breastworks and the attack failed. Eventually Sherman reached the railway and opened the Allatoona Pass to his trains and Johnston again fell back to a new position from Kenesaw Mountain to Lost Mountain. Opposite this position again Sherman intrenched himself, waiting till a lull in the heavy rains should enable him to recommence active operations. He still, however, kept up his contact with Johnston. He says himself: "Still I pressed operations with the utmost earnestness, aiming "always to keep our fortified lines in absolute contact with the "enemy, while with the surplus force we felt forward, from one flank "or the other, for his line of communication and retreat."[1] At last Sherman made up his mind to attack Johnston's position. He gives as his reasons for doing so that his men had settled down into a conviction that he would not assault fortified lines, and that he considered that an army to be efficient must not settle down to one single method, but must be prepared to execute any plan which promises success.[2] The assault was made simultaneously at two points on the 27th June, but without success, the Confederates behind their intrenchments beating back every attack. The Federal loss was three times greater than the Confederate.

After this failure Sherman gave up the attempt to attack fortified lines, and again moved his right towards the Chattahoochee River, threatening Johnston's communications with Atlanta, leaving Thomas intrenched opposite Johnston. By so doing he placed Johnston in such a position that he must either move from his intrenchments and attack Thomas in his chosen position, or else retreat across the Chattahoochee, in which case Sherman hoped to catch Johnston in the confusion of his retreat, especially at the crossing of the river Johnston, as soon as he was aware of Sherman's movements, retreated

[1] Sherman, "Memoirs," vol. ii, p. 57.
[2] Fletcher, vol. iii, p. 331. Sherman, vol. ii, 61.

but having taken the precaution of preparing a strong bridge-head was able under its protection to withdraw his army across the river in safety.

Sherman himself, speaking in his Memoirs of this campaign, says that his tactics therein were to intrench a moiety of his army in front of the enemy and turn his flank with the rest. His army was so superior in numbers to that of Johnston, that he could do this with scarcely any risk, the force left in front being always sufficient with the aid of intrenchments to beat off any attack Johnston might make upon it, while the turning force was quite strong enough to hold its own even against Johnston's whole army, at least until the part left behind, which would of course quickly discover if the enemy had moved from before it, could come up to its assistance. Accordingly we find that every time the operation was tried Johnston fell back. Under the existing circumstances of the Confederacy this result was perhaps sufficient, as their resources were gradually being exhausted, and the wresting from them of so much territory was an effectual means of still further weakening them and preventing aid from being sent to Richmond, where the great struggle was going on. But it will be observed that no decisive result was obtained. Johnston was only forced back very slowly, and his army when it crossed the Chattahoochee was nearly as efficient as when it first fell back from Tunnel Hill. It had taken Sherman more than two months to force his enemy back 100 miles. If, therefore, the circumstances had been different, if the Confederacy instead of becoming more and more exhausted by the prolongation of the struggle had wanted to gain time for the development of its resources, Sherman's operations would not have been adequate, as his enemy though falling back would have been gradually increasing in strength, while he would himself have been growing weaker from the necessity of leaving troops to guard his lengthening lines of communication, till at last the superiority in numbers might have been transferred to his enemy. To avoid this he must have brought his enemy to decisive action at any risk.

General Remarks on the Experience of the American War.

In this war we see attacks on intrenched positions almost always repulsed, except when delivered against *very* demoralized troops, as when Lee attacked on the second day at Chancellorsville, or with overwhelming superiority of numbers. General Brialmont, in his work "On the Fortification of the Field of Battle," which has recently appeared, quotes a remarkable instance of what can be done even against great superiority of force, from a report of General Wright, who commanded the 6th Federal Corps d'Armée at the sieges of Richmond and Petersburg. The passage is too long to give here *in extenso*, but the principal points are these:—towards the end of the siege of Petersburg, General Wright attacked the intrenched line of the Confederate outposts about 600 or 700 yards in front of their principal line of defence. Eventually the line was carried, "but it is

"not the less true that we had two divisions in line against a hand-"ful of infantry, deployed in a single rank, and that the number of "our killed exceeded the total of the enemy's strength. If the in-"trenchment had been defended by two ranks of good troops, it is "probable that it could not have been carried by the whole Corps "d'Armée."

A few days later it appeared to the Federal leaders that the extension of the lines on both sides must have so reduced the strength of the Confederates at all points as to offer a favourable opportunity for assaulting their main line of defence. This line of defence, seen from the position occupied by the Federals, prevented the appearance of a continuous parapet with ditch, supported at intervals by flanking batteries and covered by a line of abatis. These obstacles appeared to them easy to surmount. Nearly the whole army corps, about 15,000 men, were massed during the night behind the intrenched line that had been previously captured. The Northern Generals calculated upon being able thus to assemble their troops in secret and traverse the space separating them from the line of abatis before the enemy could offer any resistance. This they succeeded in doing, but then found that the obstacles consisted of two lines of excellent abatis separated by a fraise. It took their pioneers 15 minutes to open a passage through these obstacles, and in that space of time they lost 1,100 men. Then the parapet was carried and it was found that it had been defended by less than one rank of infantry. General Wright remarks on this:—

"What must we conclude from this remarkable example? All the condi-"tions are in our favour; we dispose of forces enormous as compared with those of "our adversaries; we are able to assemble them secretly within 600 yards of the "enemy, and we arrive in front of their ditches before they are able to think of "resistance; we are favoured besides by a thick fog, which renders the action of "their artillery almost *nil*, and we only obtain the advantage with immense loss, "because the enemy's strength is less than half the minimum recognized as indis-"pensable for the defence of a fieldwork. The conclusion to be drawn from this "attack, *is that a simple trench, defended by two ranks of infantry, covered by abatis "or other obstacles, and placed on a site which permits the range of the new arms to "be utilised, is absolutely impregnable except by surprise.*"[1]

Sherman remarks in his Memoirs:—

"During this campaign, hundreds if not thousands of miles of intrenchments were "built by both armies, and as a rule whichever party attacked one of them got the "worst of it."[2]

The Generals on both sides finding the difficulty of attacking intrenched positions were obliged to seek other methods for dislodging their enemies. Outflanking movements were therefore largely resorted to. Sometimes when a General wished at all cost to bring his enemy to action, he attacked in front at the same time that he sent a force to turn the adversary's flank, as Lee did at Chancellorsville. At other times, when it was sufficient to dislodge the enemy from his position, a defensive attitude was maintained in front, while a force was sent

[1] Brialmont, "Fortification du Champ de Bataille," p. 17 *et seq.*
[2] Sherman, "Memoirs," vol. ii. p. 56.

to menace the enemy's communications, as was the case several times during Sherman's Atlanta campaign, and also at Centreville after the second battle of the Bull Run. In every case this manœuvre was attended with success when the adversary was unable himself to take the offensive, and attack one of the divided portions, either on account of the inferior quality of his troops or on account of his weakness in numbers.

With regard to the effect on the *morale* of an army that is produced by the continual habit of intrenching, General Sherman says:—

"The habit of intrenching certainly does have the effect of making new troops " timid. When a line of battle is once covered by a good parapet, made by the " engineers or by the labour of the men themselves, it does require an effort to make " them leave it in the face of danger; but when the enemy is intrenched, it becomes " absolutely necessary to permit each brigade and division of the troops immediately " opposed to throw up a corresponding trench for their own protection in case of a " sudden sally. We invariably did this in all our recent campaigns, and it had no " ill effect, though sometimes our troops were a little too slow in leaving their well- " covered lines to assail the enemy in position or on retreat." "On the 'defensive' " there is no doubt of the propriety of fortifying; but in the assailing army the " General must watch closely to see that his men do not neglect an opportunity to " drop his precautionary defences, and act promptly on the 'offensive' at every " chance."[1]

The nature of the works used in this war may be seen from Sherman's description:—

"The enemy and ourselves used the same form of rifle-trench, varied according to " the nature of the ground, viz.: the trees and bushes were cut away for a hundred " yards or more in front, serving as an abatis or entanglement; the parapets varied " from 4 to 6 feet high, the dirt taken from a ditch outside, and from a covered way " inside, and this parapet was surmounted by a 'head-log' composed of the trunk " of a tree from 12 to 20 inches at the butt, lying along the interior crest of the parapet " and resting in notches cut in other trunks which extended back, forming an " inclined plane, in case the head-log should be knocked inwards by a cannon- " shot."[2]

The men of both armies soon became very skilful in constructing these works, and became so convinced of their value as not to require any order for their construction. Sherman, however, tried to spare his men by authorizing each division to organize a negro pioneer corps of 200 men, who worked at night while the soldiers slept, and slept during the day.

The trace of the works used in this war was usually a more or less continuous line of trench following the features of the ground, and sometimes strengthened at intervals by batteries or redoubts of stronger profile. The following description of the defences of Petersburg is taken from a paper by Lieutenant Featherstonhaugh, R.E.:—

" At intervals of 200 or 300 yards or more, according to the ground, were batteries " thrown forward as salients, and traced either as small bastions, demi-bastions, or " lunettes; these were united by a line of parapet running from the flank of one to that " of the next. These batteries therefore were the vital points of the line, and in the " construction of them lay the great difference in strength of the line to the north of the

[1] Sherman, "Memoirs," vol. ii, p. 396.
[2] Ib. vol. ii, p. 55.

"James from that to the south of it. The batteries on the north side of the river "were amplified into forts having ditches and palisaded gorges, while those on the "south side had neither one nor the other."

The profile of the lines was that of a first parallel, the trench inside being sometimes very narrow. The parapets of the batteries were thicker but there were no ditches on the south side. A row of *chevaux de frise*, and sometimes two rows, are placed before the lines; in front of all were the rifle-pits for the picquets. Bomb-proofs were extensively used.[1]

The method of fighting used is thus described by General Sherman:—

"We were generally in a wooded country, and although our lines were deployed "according to tactics, the men generally fought in strong skirmish-lines, taking "advantage of the shape of the ground, and of every cover. We were generally the "assailants, and in wooded and broken countries the 'defensive' had a positive "advantage over us, for they were always ready, had cover, and always knew the "ground to their immediate front; whereas we, their assailants, had to grope our "way over unknown ground, and generally found a cleared field or prepared en- "tanglements that held us for a time under a close and withering fire."[2]

To sum up, we find in this war that the thick nature of the country rendered it necessary for armies to intrench themselves to guard against being surprised by the enemy, who could approach closely under cover. Positions thus fortified proved as a rule impregnable to frontal attack unless the defenders were utterly demolished or very greatly outnumbered. (It must, however, be remembered that attacks were rarely prepared by the concentrated fire of masses of artillery, because the nature of the country did not permit of bringing large numbers of guns to bear on selected points, and also perhaps because the effect of such concentrated fire was hardly appreciated.) Outflanking movements were therefore much employed, and were usually successful, when the troops holding the position were either ignorant of what was going on by reason of the closeness of the country, or so inferior either in quality or number as to be unable to take the offensive. Lee, by his own skill and the mobility and fighting power of his small army, was able to keep at bay for a long time the far more numerous but cumbrous and unwieldy armies of his adversaries, and we see in many instances that intrenchments, though frontally strong, were unable to equalize good and bad troops and generalship, when their flanks could be turned either tactically or strategically. Lee, by his combination of intrenchment at one point to cover his retreat and vigorous offensive at another to strike the flank or communications of his enemy, seems to have hit upon the key to successful operations under modern conditions.

It should be mentioned that in the American war the infantry was armed generally with a muzzle-loading rifle, small bodies only having breechloaders in the later years of the war, and the artillery consisted of about two-thirds smoothbore, and one-third rifled guns in McClellan's Army of the Potomac. Later on the proportion of rifled guns increased, but it was found that the wooded country scarcely

[1] Prof. Papers, R.E., vol. xiv.
[2] Sherman, "Memoirs," vol. ii, p. 294.

ever permitting the artillery to engage at great distances, robbed the rifled gun of many of its advantages, and a certain number of smooth-bore bronze howitzers were retained, which did excellent service throughout the war.[1]

War of 1866.

The next great war, that of 1866, presents no very striking example of the use of intrenchments, and the Austrians were put at such a disadvantage by being armed with the muzzle-loading rifle, opposed to the Prussians with the needle-gun, that it is difficult to draw any general conclusions from the fighting. We find, however, that on the field of Königgrätz a few batteries were thrown up and strengthened with rifle-trenches; the west side of Lipa was put in a state of defence and the woods in front of it strengthened with abatis; and on the left of the position Nieder Prim and Problus and the western and southern edges of the Britzer Wald were put in a state of defence. These works were not extensive, but we see that during the battle the Prussians never succeeded in forcing the Austrian front on the Bistritz in spite of the superiority of their infantry arm. Their ill-success seems to have been not a little due to the superiority of the Austrian artillery not only in number, 160 guns against 132, but also in efficiency, and the circumstance is worth noticing as another example of the frontal strength of a good position, so long at all events as the assailants cannot bring an overwhelming fire of artillery to bear upon it.

Franco-German War, 1870-71.

This war is one of peculiar interest, inasmuch as it took place between two of the most highly organized armies in the world, both armed with modern weapons, and was carried on in the heart of Europe in a country presenting no abnormal features, and we may therefore hope to draw from it lessons of very general application.

It will be useful for our purpose to, as it were, analyse one or two of the battles, to notice their principal features, and how the final result of each was brought about.

The first important actions of the war were the battles of Spicheren and Woerth, both fought on the 6th August, 1870. In both battles the Germans attached the French in position and were victorious.

Battle of Spicheren.—At Spicheren the advanced guard of the 1st German army attacked the 2nd French corps which occupied a position with its right on the heights of Spicheren and its left in the valley leading to Forbach. After advancing some distance they were brought to a standstill, but managed to hold the ground they had won, though with much difficulty, till reinforcements arriving they eventually forced the French to retire. The most significant points about the battle appear to be these: the French position, though apparently strong, had several weak points. The only position from which artillery could be brought to bear upon the ground in front of

[1] Comte de Paris, "Guerre Civile en Amerique," vol. i, p. 555.

the right wing was the Rotherberg. But the guns here could be easily subjected to a cross-fire and were early compelled to retire, when the Germans could advance against the French right untouched by the fire of artillery. Again, the French right was posted on steep heights from which thick woods descended to the low ground; the lower edge of these woods was not held by the French, probably for fear of having their retreat compromised, so when the Germans advanced they could reach the woods without much loss, and then could make their way up the slope under cover, not encountering serious resistance till they reached the crest, and drove the French out of the wood. But observe, as soon as they reached the further edge of the wood and tried to come out into the open, the French fire from their second position behind Spicheren absolutely stopped them and drove them back quickly under cover, and they could not advance further on this part of the field until helped by events elsewhere. Again, the French position was partly on the hills, partly in the valley, and in consequence the battle was divided into two almost distinct actions, one on the heights and the other in the valley. In both actions the Germans were at one time brought to a standstill; above, they could not cross the neck between the Spicheren and Forbach heights, not being able to bring up enough artillery to subdue the French fire, and below, they could not capture Stiring Wendel. But gradually the French troops, which had originally occupied the slopes forming the connecting link between the valley and the heights, got drawn off partly to the fight below, partly to that above, so that when German reinforcements crept up those slopes they met with comparatively little resistance and turned the second French position on the Forbach heights. Then, as Forbach itself was at the same time threatened by the 13th German Division, General Frossard gave the order to retreat. At one period of the battle the Germans were in a very critical position: the last troops on the field had been sent into action, and an advance in force on the part of the French might have had a serious result. But here a difficulty of the defensive attitude shows itself. Frossard did not know how exhausted the Germans were; he could not tell that there were not many troops behind them, as he knew the main armies could not be very far off, and therefore he was by no means anxious to leave his position to attack, with the risk of finding himself met, when he had descended from his point of vantage, by superior numbers of fresh troops; and so the chance passed away for ever, as German reinforcements afterwards arrived.

On the whole we see in this battle the assailants able to advance as long as they can obtain any sort of cover, but brought to a standstill when they have to encounter the defenders' fire on open ground, especially when they cannot bring up a superior artillery. The battle is eventually won by the piercing of the defenders' position at a weak point, and the appearance of a fresh force threatening the French line of retreat. On the French side we see the weakness of a position partly on heights, partly on low ground, and the disadvantage of woods in a position, of which the further edge cannot be held. A disadvantage of very steep ground is shown in the case of the Rotherberg, where the

French shelter-trenches could not see the steep slopes, so that when the Germans reached the foot of the hill they were under cover, and could climb up unseen by the French till within a few paces of the trenches.

Battle of Woerth.—The battle of Woerth is also instructive. The French occupied a position on heights forming the western boundary of the valley of the little river Sauer. The length of the position was about 3½ miles, and it was held by about 45,000 men. The front was covered by the Sauer, which was difficult to cross except at the bridges; and the meadow land, averaging 1,000 paces in breadth, which bordered its banks, afforded no cover. The slopes of the valley were steep and covered with thickly planted vineyards and gardens. Froeschwiller was the crowning feature of the position standing on the highest point of the plateau, astride the road to Reichshoffen, which was the French line of retreat. The undulating nature of the ground, and the cover which it afforded, favoured the employment of a large number of skirmishers and concealed the reserves from the enemy's view, and the French had strengthened the interior of the position by field-works.[1] At the same time it does not appear that there was any well-defined main line of defence with a clear field of fire in front.

When the serious part of the battle began, the artillery of the 5th German corps in conjunction with 24 guns of the 11th corps, 108 altogether, came into action against the French front about 10 A.M. This mass of artillery soon reduced the whole line of French artillery to silence. Then the infantry of the 5th corps was sent forward to attack the heights behind Woerth, supported by part of the 11th corps on the left. One brigade of the 5th corps moved across the stream, succeeded in reaching the foot of the heights and even in mounting them a short way, but was then driven back to the foot of them again by counter-attacks by the French supports and reserves, and at noon, "the 3rd corps of the 3rd army in first line were committed in greater or "less force to an engagement, in the course of which advantages which "had been derived had either to be again yielded owing to heavy losses "or were maintained only with difficulty against the vigorous on-"slaughts of the French."[2]

Then the commander of the 5th corps determined to press on the action, and sent forward more of his corps, and his determination was approved of by the Crown Prince, who arrived on the field about 1 P.M. Gradually the whole of the 5th corps was absorbed into the battle beyond the Sauer, and nothing remained in the German centre behind the actual fighting line except the line of artillery. The fighting was a series of desperate rushes forward by portions of the German line to seize some point of vantage, and then defence of this point against counter-attacks by the French. "The whole of the struggle had up to "this time consisted of a series of offensive movements on *both* sides. "The nature of the ground and the powerful effect of the fire caused "the assailant terrible losses on each occasion, and enabled the defender "generally to hold his position. It was only by degrees and by

[1] Pruss. Off. Acct., vol. i, p. 149.
[2] Pruss. Off. Acct., p. 163.

"dint of hard fighting, that the Prussian troops gained any ground."[1] At length the Germans reached the edge of the plateau, and their difficulties increased, for they now masked the fire of their own artillery from the opposite side of the valley, and desperate efforts were made to bring some batteries across the stream and up to the heights, and eventually five batteries were brought into action. But the situation was so grave that "to persist under such circumstances demanded the "unshaken confidence of the General commanding, the energy of all "commanders, and the entire devotion of the troops. The successful "attack of the 11th army corps upon the enemy's right wing was the first sign of the long looked-for support."

During the attack of the 5th corps on the French front the 2nd Bavarian corps had attacked the left wing and the 11th corps the right wing of the French position. The Bavarian attack had been checked, but the 11th corps finding the French right somewhat *en l'air*, had succeeded in driving it in, and was now pressing forward and joined its right to the left of the 5th corps, in conjunction with which it captured the village of Elsasshausen, and in the words of the official account:—

"After a struggle of several hours, both Prussian corps had succeeded in driving "in the French army upon the key-stone of their position at Froeschwiller, in "destroying the greater part of their cavalry, and from their position on the south "threatening the line of retreat upon Reichshoffen. But these corps were gradually "losing blood in isolated struggles against the stubborn resistance of the brave "enemy." "The arrival of German brothers-in-arms was more and more to be "desired, in order by their fresh strength to ensure the success of the assault upon "the last bulwark of the enemy."

Thus three corps of German troops, numbering at least 75,000 men, were not sufficient fully to ensure the ultimate defeat of the 45,000 French, and it was not till the arrival of the Wurtemburg division and part of the 1st Bavarian corps that Froeschwiller was at last taken and the final victory won.

In considering this battle we see in the first place that it required a numerical superiority of at least 2 to 1 to secure the victory, for the Germans cannot have had less than 90,000 men engaged altogether. Therefore the value of the French position for defence must have been great, although the right flank at all events was weak, and was turned without great difficulty by the 11th corps. It is very doubtful whether the front attack would have eventually succeeded if the 11th corps had not been able to make its turning movement so successfully through what must be considered as insufficient care on the French part for the protection of their flank.

The fact, however, that the 5th corps were able to advance so far as they did requires a little attention to be paid to it. They were favoured in the first place by the superiority of their artillery, which entirely silenced that of the French. Moreover, from the nature of the French position on steep slopes within artillery range of the opposite side of the valley, the German guns could very materially aid their own infantry by firing over their heads, until the latter reached the edge of the plateau. The nature of the slopes also, broken and

[1] Pruss. Off. Acct., vol. i, p. 172.

thickly covered by vineyards, gardens, hedges, and walls, though at first it would seem as if it would favour the defence by giving so many lines to which to hold, yet probably was more favourable to the attack than would have been an open slope, for any wall, hedge, or piece of cover, if once it could be captured by a rush, gave a point which the assailant could hold on to, and under cover of which he could get breath for a further advance, so that determined troops like the Germans could slowly advance, though not without heavy loss. When once the edge of the plateau was reached, however, and their guns were masked, the Germans were checked, and the utmost exertions had to be made to re-open the artillery fire. In order to be able to find a position where they could again come into action, the batteries that crossed the valley had in many instances to venture well within musketry range of the French infantry.

Battle of Gravelotte.—The battle of Gravelotte is one of extreme interest and exhibits features of the utmost importance.

On the 17th August the French army under Marshal Bazaine took up a position in front of Metz, the 6th corps on the right at Roncourt and St. Privat, next to it the 4th corps, next the 3rd, and the 2nd on the left at Point du Jour and Rozerieulles. The Imperial Guard was in reserve.

The French position lay upon an open and broad ridge, the western slope of which fell with a gentle declivity forming a sort of glacis, lending itself to the full effect of artillery and infantry fire. The reserves could be placed on the reverse slope under cover. In front of the centre and left was a wooded ravine. The left flank was supported by the works of Metz and the valley of the Moselle, and along the front of the 2nd and 3rd corps a connected system of shelter-trenches, gun-pits, and covered communications was formed. Homesteads, as Point du Jour, Moscou, and St. Hubert, were fortified.

The right wing of the position near St. Privat rested on no natural obstacles, and as there was no engineer park with the 6th corps, no intrenchments, with the exception of a few shelter-trenches, were thrown up at that point. The position was about 7 miles in length and was occupied by a force of from 125,000 to 150,000 men.

In the battle that ensued no part of the French main position was forced except on the right flank. In front of the village of Gravelotte the Germans brought into action a formidable force of artillery, which quickly overpowered that of the French opposed to it, and then the infantry advanced. Across the ravine they were able to press, but when they reached the open ground on the other side their advance was checked by the French fire sweeping the open slopes. But there was a farm-house, St. Hubert, a few hundred yards from the edge of the ravine. On this the German artillery concentrated their fire, and the German infantry, taking advantage of rough ground and quarries, and the little cover that potato ridges and the low banks of a lane afforded, by little groups, by twos and threes, gradually crept on to within a short distance of the farm. Then the artillery played on it and the musketry drove the garrison from their windows and loopholes, till at last a rush forwards was made and the post was captured. But

no further advance could be made. The guns at Gravelotte were too far off to prepare the way efficiently for a further forward movement, and the attempt to bring guns across the ravine was a failure as far as any important results were concerned, though three batteries did succeed in getting across and maintaining themselves for some time. Without efficient aid from artillery the Germans could not make any successful attack on the lines of French trenches, sweeping the ground in front with their fire, and presenting no definite object on which to concentrate fire and efforts. So along the rest of the front of the position, the German infantry, aided by their guns, advanced to a certain distance and captured various advanced posts, but were brought to a standstill before reaching the main French line.

Meantime, on the right flank of the French line an extremely instructive drama was being played. After the capture of Ste. Marie aux Chênes the Prussian Guards formed up opposite St. Privat. It was intended that they should wait until the movement of the Saxon corps round the extreme French right should be completed. But before this took place Prince August of Wurtemburg became impatient and ordered the Guards to attack St. Privat. General Pape, commanding the 1st division, remonstrated, saying that St. Privat had not as yet been cannonaded to any extent, and that an attack without sufficient artillery preparation would be very hazardous. But his objections were over-ruled and the advance was made. It was carried out by company columns in first line, covered by the shooting subdivisions and followed by half battalions. The village of St. Privat looks down an open glacis-like slope for some 2,000 or 3,000 yards, and is a strongly built village surrounded by gardens enclosed by stone walls. From houses and walls the French poured forth a murderous fire under which the German columns melted away into small groups and loose knots of men who, throwing themselves on the ground, gave up the advance, but succeeded with great courage in maintaining the ground they had won. The first attack of the Guards had failed. Then the Saxons began to enter the fight, driving the French extreme right from Roncourt. After the capture of Roncourt, all the Artillery of the Guard and Saxon corps were brought up in a vast arc round St. Privat. Under the concentrated fire of these guns walls crumbled. houses fell or were set on fire, and nowhere could rest or shelter be obtained by the hapless French garrison. Again the German infantry advanced, but the artillery ceased not their fire. Until their men were actually in the village the hail of shell went on. No respite to recover themselves even for an instant was given to the French until the helmeted infantry were pouring into the village on all sides and Canrobert was forced to give up the hardly contested post. With its loss the rest of the French position was so compromised that Bazaine withdrew his army next morning within the protection of the forts of Metz.

In this battle it is especially noticeable that the main French position was nowhere forced except at St. Privat. Wherever a certain amount of cover could be obtained, or a definite object of attack presented itself, against which a concentrated fire of artillery and infantry could

be brought, there the assailants gradually advanced, but whenever they came face to face with a continuous line of defence without salient or exposed points and with a clear field of fire in front, there the forward movement was stopped. But it must be observed that except about St. Privat the support that the German artillery could give to their infantry was to a certain extent circumscribed. Before Gravelotte the ravine prevented the guns from advancing in accordance with the advance of the infantry, and therefore, after the capture of St. Hubert, it was not in a position to prepare the way very effectively for a fresh advance by subduing the fire from the French main position; and between the woods of La Cusse and Genivaux the artillery of the 9th corps suffered so severely in its first rash entry into action that for the rest of the day the utmost it could do was to just maintain its ground, and it was not in a position to obtain the mastery over the French fire, which alone could enable the infantry to attack with success.

Again, let us take note of the course of events on the French right. There the French occupied a strong village dominating a wide open slope. An attack directed against this by closed bodies covered only by a thin chain of skirmishers (much as the Russian attacks were made on Plevna), and inefficiently prepared by artillery, failed disastrously; an example of how an attack should *not* be made. Next we see exhibited the conditions under which an attack may be expected to be successful. In the first place the French artillery is silenced. Then a concentrated fire from an encircling position is directed upon a definite and clearly recognizable locality which is the key of the position. This locality is a village, which though strong in some ways, yet when rained upon by shells gives little shelter to its defenders, who are therefore shattered and driven from the lines whence they had previously delivered their sweeping fire. Opportunity is thus given for the infantry again to advance. This terrible fire is kept up until the very moment of the assault, giving the defenders no time to recover themselves before the attacking infantry is actually in the streets and the place is lost.

Generally speaking, this battle seems to show that a position giving cover to the fighting line and reserves behind earthworks or natural ground with a clear field of fire in the front may be considered impregnable, at all events when circumstances do not permit of a concentration on some decisive point of a great weight of artillery fire, and its continuance up to the moment of the assault. But we also see that if the position contains a certain class of locality, such as a village which may be subjected to a concentrated and continued fire from a superior artillery, such a locality is a point against which attacks may have a chance of succeeding, and therefore demands a great share of attention, especially if it is a vital point, the loss of which may endanger the loss of the position. The question yet remains to be solved as to whether field artillery can produce a sufficient effect upon good earthworks to give an assault a fair chance of success.

Battles on the Lisaine (*See* Plate IV).—A very remarkable episode in the war was that formed by the operations before Belfort in January,

1871, and one in which field intrenchments played a prominent part.

Von Werder, in command of about 43,000 men, was entrusted with the task of protecting the siege of Belfort against any attempt of Bourbaki at the head of some 150,000 men to relieve the fortress. Bourbaki's army was collecting behind the Doubs, and in the first week in January it became evident that he was about to advance. Von Werder was at the time near Vesoul, and two alternative courses of action offered themselves to his choice: either to fall on the enemy's flank on his march in the hope of defeating him, and forcing him to abandon his attempt to relieve the fortress, or to retire and place himself across the French line of march. The first alternative seemed too dangerous in view of the immense numerical superiority of the French army and the obstacles presented by the hilly country, as the Germans might find themselves wasting their strength in trying to force the defiles on the enemy's flank, while Bourbaki continued his march on Belfort with his main body. Von Werder therefore chose the second alternative, but delayed the enemy's march by a partial attack on his flank at Villersexel.

The region over which Bourbaki could advance was limited on the north by the Vosges Mountains, almost impassable in winter, and on the south by the Swiss frontier, the space between these limits being about 22 miles. The obstacles formed by the Doubs, the Allaine, and a canal, divided this space into two parts. As Bourbaki's army was composed of very raw material and therefore unfit for much manœuvring, it was not probable that he would divide his forces by these formidable obstacles, and as the main roads, Lure-Belfort, Besançon-Belfort, ran to the north of the obstacles, it was considered probable that the attack would be made on the position Montbéliard-Chagey, and this was accordingly chosen as the main position, covered by the little river Lisaine. The flanks of this position were protected tactically on the left by the Allaine and canal, and on the right by the difficult woods north of Chagey. But it was necessary also to prevent wide turning movements and to guard against the possibility of the attack being made between Montbéliard and the Swiss frontier. Therefore a detachment under Colonel Debschitz was detailed to watch the space from Montbéliard to the Swiss frontier, to oppose a strenuous resistance to any diversion made by a turning force during the attack on the main position, but if the main attack should fall on him, to retire to the position of the Allaine, where he would be within reach of the support of the troops in the main position. Similarly a force was placed on the extreme right at Frahier and Chenebier, to guard against turning movements on that side, and a detachment was sent out in advance to give warning of any movement of the French in that direction. A movement in this direction of the bulk of the French army was not, however, anticipated, as it was known that Bourbaki would have to hold pretty closely to the railway for purposes of supply.

It will be observed here that the Germans, being numerically very inferior, were obliged to prepare for the contingency of being turned

on either flank while being attacked in front, and were therefore obliged to watch the whole region available for the French advance, in spite of their own small numbers. But a judicious appreciation of the conditions enabled the German General to limit his main position, although at best it was very extensive for his little force.

The position actually taken up by Von Werder possessed certain advantages. The river Lisaine could only be crossed easily at certain defined points, and as the country was almost impassable on account of the snow except by the roads, the points where attacks might be expected could be pretty well determined beforehand. These points were carefully strengthened by fieldworks. The event proved the correctness of the views entertained by the German General, although hard frost upset some of his calculations by rendering the streams and canal passable by troops on the ice and making the communication between different parts of the position very difficult. The French actually delivered their principal attacks at the points where they were expected.

On the 15th January the attack was delivered on the position Montbéliard-Chagey. The French succeeded in forcing the Germans out of the town of Montbéliard, but not in gaining possession of the castle, nor could they advance from the town against the heights beyond. All along the rest of the line the French were completely repulsed. They advanced as a rule in dense columns after a preparatory fire of artillery which produced little effect. The German artillery as a general rule succeeded in bringing the attacking columns to a standstill, and in the few cases in which they did not quite succeed in so doing, the infantry completed the task, though not without severe fighting and drawing on their reserves. The German artillery fired almost entirely against the French infantry, regardless of the loss they might themselves suffer from the hostile artillery, which latter, however, did but little damage.

The next day the attacks were renewed, but were all again repulsed along the main line, not being delivered simultaneously at all points, so that in some cases German guns and troops were able to take part in the action at two different points successively. On the extreme right of the position, however, Chenebier was captured by the French, and the German troops forced back beyond Frahier. This event compromised the rest of the line, so Von Werder ordered a counter-attack to be made on the place, sending for that purpose his last remaining reserve. Soon after these troops had been sent off, a night attack was made by the French on Héricourt and Bussurel, and Von Werder having no further reserve, passed an anxious time until at last the attack was beaten off. By morning he succeeded in collecting afresh a small reserve.

On the 17th the Germans attacked Chenebier before daylight, and although they did not succeed in capturing it, yet they held the French fast and prevented them from undertaking further operations against the flank of the main line. This again repulsed various desultory attacks, which, however, had now lost their energy, and the

next day the French were obliged, on account of their deficient *morale*, to commence a retreat.

Here we see a successful defence by a force numerically very inferior, its success being due to various causes. Firstly, the French artillery was very inferior, so that it could not effectually quench the defenders' fire. Again, the French infantry was only partially trained, which necessitated the attack being made in dense masses, thus exposing them to great loss. The French arrangements were also not good, as their attacks were not simultaneous all along the line, so that the Germans had time to recover themselves and take part in the fighting at another point, after repulsing an attack at one point. The state of the country too, and the weather, was against the French, forcing their attacks to be made at certain points well prepared for their reception, and inflicting much suffering and discouragement on their young, poorly clad, and poorly supplied troops.

Investments of Paris and Metz.

We find very interesting instances of the use of intrenchments for the purpose of strengthening defensive positions in the investments of Metz and Paris by the German armies. By the aid of their works they were enabled to closely invest, and entirely prevent from breaking out, an army, in the case of Metz, very little inferior numerically to themselves, and in the case of Paris, even superior in numbers although inferior in quality.

It will be useful to examine a few of the details of these investments.

Metz.—From Captain Paulus' work on "the Investment of Metz," we learn that the principles laid down for the fortification of the line of investment were as follows:[1]—

The main object was to provide defensive positions, which, as they were continually strengthened, should gradually attain such a strength for passive defence that they could be held by a small force, so as to leave as many troops as possible available for the reinforcement of neighbouring positions that might be attacked.

For this purpose the utmost care was to be taken to have a wide and clear field of fire; where practicable, natural or artificial obstacles were to be used.

Where the line of investment ran through woods, strong abatis formed by degrees extended to a breadth of 200 paces, and to prevent interfering with fire the boughs were cut off one metre above the ground.

Cover was provided for infantry and artillery behind the obstacles, to command the front, and if possible flank the obstacles. When it was necessary to leave woods before the front, the position was chosen generally about 300 paces behind the line of obstacle, so as to cover with a powerful fire the enemy as he debouched from the felled and entangled edge of the wood.

[1] Paulus, "Cernirung von Metz," p. 34.

For such covered positions natural tactical points of support were everywhere used in first line, such as farms, villages, and coppices.

Where such did not offer themselves, rifle-trenches and gun emplacements were preferred to redoubts. To this preference the consideration led that trenches best allowed of every weapon being used without giving the enemy a good mark for his artillery. Redoubts would naturally draw fire and cause considerable loss to the garrison without giving really better effect than trenches.

The trace of the lines depended on the ground. Especial care was taken that all ground in front should be commanded. Angles in the line gave flanking fire, and openings, often covered by redans in front, facilitated the assumption of the offensive.

The profile of the trenches varied; on an average a height of cover of 1m. 30 (4′ 3″), was equally divided between remblai and excavation, with a breadth of trench of about 3 feet. Sometimes a stronger profile was given to cover closed bodies.

Great care was required in draining the works.

As regards artillery, care was taken to provide emplacements at least for the divisional artillery. Single gun-pits were generally employed at 20 paces interval. Cover for the limbers was always given when the ground did not afford it, but often for the limbers only, not for the teams.

At first the gun-pits were made small, with a breadth in front of 3m. (10′) and in rear of 4m. (13′), but later on that was found insufficient, and the terrepleine was increased to a breadth of 4m. (13′) in front and 5m. 60 (18′ to 19′) in rear. As regards profile, at first sunken pits were used, but were found difficult to drain, and the gun was afterwards usually left on the natural surface, which gave a better foundation than an excavation in which water was apt to stand. Then a ditch in front was necessary, generally made shallow and broad, so that as many labourers should be able to work at once as possible. Flanking as well as frontal breastworks were always thrown up, and small trenches made for the detachments close to the side epaulments.

More stress was thrown upon covering the emplacements from the view of the enemy than on obtaining actual perfect cover from projectiles; therefore bushes, vines, &c., were often used as screens.

Whether one or more lines of defence should be made, depended much upon ground and circumstances. As a general rule, perhaps it may be said that there were first outpost positions slightly intrenched, then the main line strongly fortified where the decisive action was to be fought, and in some places a third rallying line.

In some cases two or more lines of trenches were made in order to bring a powerful fire upon certain spaces.

Influence of Works on Strength of Occupation of Position.—As regards the influence that the completion of the works had upon the number of men that were considered necessary for a due occupation of the line of investment, we find that:—

In the first position, assumed by the investing army, two sections, having a total outpost line of 14,800 paces, were guarded by cavalry

alone, 3,500 horses and 6 guns. The remaining 40,100 paces of outpost line was guarded by 145,700 infantry, about 12,000 cavalry, and 622 guns. This gives on an average 3·6 infantry soldiers per pace, with 82 cavalry soldiers and 4·25 guns per 1,000 infantry, total about 8,000 men per mile. The sections guarding the roads to Gravelotte and Thionville being most liable to be attacked were especially strong, being occupied by 3·8 and 3·65 infantry per pace respectively, and behind the Gravelotte section and the adjoining ones on either hand, stood besides, in reserve, two corps d'armée and a cavalry division.

On the second day of the battle of Noisseville, a great part of the line (16,000 paces) on the left bank of the Moselle was left with only one infantry soldier per pace.

When we turn to the last position of the investing army from the middle to the end of October, we find the whole line now guarded by infantry, and the average strength to be 2·5 infantry per pace, with 90 cavalry and 4·7 guns per 1,000 infantry, showing the infantry considerably weaker and the cavalry and artillery slightly stronger than in the first position, total about 6,000 men per mile. On the sides most likely to be attacked, 3 infantry per pace could be collected in a few hours, while on sides not especially threatened we find an average strength of 2 infantry per pace.

Therefore the completion of the works allowed the average strength to be diminished from 3·6 *infantry per pace to* 2·5.

Early in the investment whole corps were kept as a general reserve, but later on, divisions or brigades of corps in first line formed local reserves. The reason for this alteration appears to have been the necessity in later stages of the investment for greater depth in the region occupied by a body of troops in order to obtain for them the shelter of roofs instead of their being forced to bivouac, so that for reserves it was better to use the second lines of corps in the investing line, than to keep back entire corps which would have to be stationed so far off as not to be perhaps available in time in case of emergency.

The average space of front occupied by a division was 3,500 paces, the strength of a division in infantry being from 8,000 to 10,000.

The total strength of the investing army in the latter half of October was about 136,000 infantry, 12,000 cavalry, and 640 guns.[1]

The strength of the French Army at its capitulation was 173,000, of which 145,000 marched out and laid down their arms; the remainder (sick, convalescents, and officers' servants) remained for a while in Metz.

Paris.

Paris (*See* Plate V).—As an example of the works used in the investment of Paris, and the way in which they answered their purpose, let us take the section from Noisy-le-Grand to Ormesson occupied by the Wurtemburg division.[2]

[1] Paulus "Cernirung von Metz," Appendix, p. 125.

[2] Heyde u. Froese, "Geschichte der Belagerung von Paris," p. 361 *sqq*.

The first work done was the provisional arrangement of the line of outposts, the putting in a state of defence of the points of support of the main fighting line, and the formation of intermediate posts in the same.

For the outpost line, portions of villages, farms, coppices, &c, were made defensible. In the main line, villages, parks, cemeteries, &c., were fortified by crenelating and loopholing walls, erecting barricades, forming trenches and abatis, and by erecting emplacements for guns. Communications between different parts of the lines were improved.

These works took from the 19th September to the end of November. They were carried out during September by infantry fatigue parties; from the 30th September by a sapper company aided by infantry working parties averaging from 250 to 500 men. The artillery threw up several emplacements for batteries.

On the 30th November began a sortie of the French, who gained possession of Bry and Champigny (*see* Plate). On the 2nd December the eastern part of Champigny was recovered; during a part of the action itself, a pioneer company worked at putting into a state of defence the part of the village retaken. On the 3rd December the French retired again.

During the first fortnight in December, after the retreat of the French, great exertions were made to strengthen the position, as many as seven pioneer companies being employed with two additional companies for two days. The work first undertaken was the strengthening the line of outposts by barricades, abatis, entanglements, breastworks and trenches for communications, and the provision of bomb-proof cover. Next a forward fighting line was arranged at the foot of the plateau, formed by a part of the village of Champigny and a line of trenches connecting it with Bry so as to close the peninsula of the Marne. Thirdly, the main fighting line on the plateau was strengthened by giving greater completeness to the defences of the villages and localities, clearing the field of fire (not only here but everywhere, in outpost and first line also), improving the profile of earthworks, connecting the localities by trenches, increasing the number of batteries, making new abatis, entanglements, &c. Besides the shelter trenches, detached works of good profile in the form of lunettes were erected in places to sweep level plateaux with their fire, and sometimes they were joined by trenches to other parts of the defences. Lines liable to enfilade were well traversed and bomb-proof accommodation was provided in many localities. This work went on gradually till the capitulation took place, and in its later stage was principally carried out by pioneer companies, as requiring skilled labour.

The annexed plan will show the general arrangement of the works in this section of the investing lines:—

First, there is a line of outposts, each post furnished with a certain amount of means of defence (in villages the routes to posts were carefully marked). This line of outposts runs from the western side of the village of Champigny by Le Plant to the railway bridge over the Marne. Next we see the advanced fighting line at the foot

of the plateaux, running from the centre of Champigny to Bry. Thirdly, there are the salients of the plateaux with batteries placed on them, protected by trenches following the shape of the ground. These trenches were placed a little below the actual crest, in order that they might be able to see the whole slope in front of them, and also to prevent their being of any use to the enemy if captured, as from them it was not possible to see on to the plateaux.

If we take the figure to represent a section of the ground, the trenches were placed at the point B in the slope, not at the actual crest A. Then further back again is another line of partly detached, partly continuous defences, consisting principally of the villages, buildings, park-walls, &c., as the village of Noisy-le-Grand, the cemetery at Villiers-sur-Marne, the park at Villiers, and the park and Château of Cœuilly with the auberge at Mon Idée, but partly also of trenches and detached earthworks. In this line, or behind it, are placed some batteries to flank positions of the advanced line, and aid in the defence of the second if the first line at the salients is captured. The salients have thus at least two lines of defence besides the outpost line and the advanced fighting line, while the curtains have only one. All the lines are greatly protected by abatis and entanglements.

The profiles of the works were carefully arranged according to whether likely or not to be exposed to artillery fire. The batteries had parapets varying from 2m. to 5m. in thickness (6′ 6″ to 16′ 6″) and had some of them their terrepleine sunk 1m. below the level of the ground, and some on the natural level of the ground. They were all well traversed; many were provided with detached powder magazines connected with the batteries by trenches, and a few had small bomb-proof shelters and blindages. The parapets gave a minimum cover of 1m. 60 (2′ 3″). The musketry trenches were 0m. 70 wide at the bottom (2′ 4″) and 0m. 70 deep, giving with the remblai a total cover of 1m. 30 (4′ 3″).[1]

The way in which these works answered their purpose will be seen from a glance at the events of the French sortie on the 30th November, 1870.[2]

Sortie of 30th November.—In preparation for the sortie, batteries had been established by the French on either side of the head of the Marne in order to sweep with their fire the peninsula of Joinville, where the sortie was to take place. The attempt was to be made by two divisions of the 1st corps, and two of the 2nd corps in first line with the third corps in reserve.

On the German side the occupation of the threatened portion of the line of investment was very weak. Part of the 12th corps occupied the ground from the Marne at Gournay to Bry, the Wurtemburg division had its 1st brigade in the position Villiers-

[1] Travaux d'Investissement.
[2] Heyde and Froese, p. 500, *sqq.*

Chennevières, its 2nd brigade from Chennevières to the Seine at Valenton, with its 3rd brigade in reserve in a central position; altogether not more than one man per pace of front, including the reserves. From this weakness and the many changes which had taken place in the arrangement of the troops in this section, it followed that at the end of November not very much had yet been done in the way of fortifying the position. Noisy, Le Plant, and Champigny had had their boundaries which faced the enemy closed by barricades, crenelated walls, and trenches, but a systematic fortification of the localities had not yet been fully carried out. The park at Villiers formed a very strong post, adequately fortified, and at Cœuilly work had been done, but not to the same extent.

In the course of the 29th November, the German head-quarters obtained sufficient information to enable them to anticipate a serious attack on the position occupied by the Wurtemburg division, and measures were taken to reinforce that part of the line. The 24th division was to cross the Marne entirely and occupy the space from the Marne to Champigny so that the Wurtemburg division should have only the section from Champigny to the Seine to guard.

The movement of the French over the Marne at Joinville began at 7 A.M. on the 30th November; by 9.30 the two divisions of the 1st corps and two divisions of the 2nd corps had effected the crossing and moved forward to the attack of the position Bry-Le Plant-Champigny. The attack took place whilst the relief of the Wurtemburg division by the 24th division was in the act of being carried out. Some Saxon battalions had already relieved the Wurtemburgers at Bry, Champigny, and Le Plant, but the relief was not yet completed in the line Villiers-Cœuilly.

The French attack was preceded by a vigorous cannonade from all the forts and batteries which could bear upon this portion of the German position. The assailants through their great numerical superiority succeeded in driving the defenders from Champigny and Le Plant without much difficulty, and then the attempt was made to advance further about 11 A.M., the 1st corps sending its battalions against the heights of Cœuilly and the 2nd through the hollow between Bry and Champigny against Villiers. They were received by the fire of the position and driven back, some Saxon battalions breaking out from Villiers and driving the French back to Le Plant. Then both French corps brought up their field artillery and began a heavy fire against the Villiers-Cœuilly position. Meantime the 3rd corps had crossed the river at Bry and driven the German outposts from the village and settled themselves there. Under cover of the heavy and well directed fire of the forts and batteries, the French then made repeated attacks on the main portion and succeeded in limiting the investing troops strictly to the position Villiers-Cœuilly, and the French advanced troops occupied a line which, starting from the fully occupied village of Champigny, ran in front of the road from Bry to Champigny and reached to the outer edge of the plateau in front of Villiers, at this point only about 500 paces distant from the advanced troops of the investment.

In these positions the troops on both sides busied themselves during the night and the next day in fortifying themselves. Reinforcements were also brought up to both sides. By the middle of the day on the 1st December, the Germans had the whole of the 2nd corps, the Wurtemburg division, the 24th division, some battalions of the 23rd division and the 21st brigade, ready to meet further attacks on the part of the French.

As no attack was made on the 1st, the Crown Prince of Saxony ordered an attack to be made on Champigny and Bry the next morning. Three battalions advanced against each village, about 7 A.M. The French were driven out by the first rush, but returning in greater strength, drove the Germans out in turn. Then occurred a series of offensive movements on both sides, by the French against Villiers and Cœuilly, by the Germans against Champigny. The vigour of the French attacks was so great that the Germans had continually to bring up reinforcements, so that all disposable troops were eventually concentrated in and immediately behind Villiers-Cœuilly. After 2 P.M. the action died away to a fire combat only. The result of the day was that the Germans succeeded in getting possession of and holding that part of Champigny which lies to the east of the road to Bry (a pioneer company worked under fire to fortify this position); everywhere else the French maintained their position.

The next day, however, General Ducrot, perceiving that it was impossible to break through the investment, ordered a retreat again across the Marne.

In these operations we see an exemplification of the principles laid down by Girard for lines of investment:—

"The defender possesses here the superiority, be it numerical or moral; but this "superiority can only be realised on the condition of introducing a new factor— "time. It is necessary to occupy much ground with small numbers; to gain time "by forcing the besieged to early deployment; to defend the ground foot by foot, "occupying several successive positions, which gradually increase in strength, "until the besieger having concentrated his forces can, thanks to his superiority "acquired by degrees, almost entirely dispense with the resources of art; it is "necessary, in a word, to construct round the fortress a kind of elastic network, "which yields at first under the stress of the attack, stretching little by little its "springs, until these springs, by their very tension, overpower the force which "stretch them and cast back the exhausted assailant behind his walls."[1]

A conclusion applicable to all defensive positions, not only to lines of investment, seems also to call for notice; that is, the great advantage likely to ensue from having, behind the points most likely to be assailed (as in this case the salients in front of Villiers and Cœuilly), a second line of defence, especially if it cannot be readily reached by the fire of the attacking artillery from its first position. If this second line exists, it will be necessary for the whole operation of an attack to be begun anew by troops already wearied by the exertions of capturing the first position, and a fresh preparation by artillery fire must be carried out, and if the previous fighting has been obstinate it is very likely that night will fall before the second attack can be brought to a successful issue, when the action must be broken

[1] Girard, "Traité des Applications Tactiques de la Fortification," Paris, 1874, p. 19.

off, and the defenders will have the night to recover themselves, strengthen their defences, and bring up reinforcements.

On the other hand we also see the assailants holding on to ground won during the day and strengthening themselves there, a course which might under certain circumstances give them a point of vantage from which further offensive operations might be carried out on the following day. The fear of such operations from the captured village of St. Privat caused Bazaine to give up the Gravelotte position, and the capture of Noisseville before Metz and of Chenebier on the Lisaine brought serious danger in both cases to the German positions, from which, however, they were saved in both instances by a vigorous assumption of the offensive in anticipation of any movement on the part of the French, which reduced the latter to the defensive and neutralized the advantage they had gained.

Résumé of Experience of the Franco-German War.

In this war we have seen the Germans successful in a large number of instances in offensive battles, a state of things which has caused a great preaching up of the efficiency of the attack as against the defence. But if we look carefully into the matter we find always certain conditions accompanying a successful attack, viz.: (a) Conspicuous defects in the defensive position, as at Spicheren; (b) great superiority in quality on the part of the attacking troops, as in some of the later battles of the war, or (c) the power of turning one or both flanks of the position, as at Woerth and Gravelotte. The power of turning a flank was obtained by the Germans in various ways;—through possessing great numerical superiority, by means of which they were able to spare considerable forces to effect the turning movement while holding the enemy fast by serious and sustained attacks in front, as at Woerth, where also the French arrangements for protecting the flanks were defective—through the weakness of the attacked flank as at Gravelotte—or through their confidence in the superiority of their own arrangements and fighting power, emboldening them to expose to a certain extent their own communications for the purpose of striking at those of the enemy, as in the great strategical movement to cut off the retreat of the army of the Rhine from Metz. Front attacks as a rule failed when made against positions having a clear field of fire, and giving good cover to the fighting line and reserves, either by the natural features of the ground or by earthworks and trenches. They sometimes, however, succeeded when made over broken ground where points of vantage could be seized by a rush and then utilized to prepare for a further advance, or where cover could be obtained and the defenders' field of fire was not clear, or where a concentrated fire of artillery could be brought upon some locality that could be thereby rendered untenable.

When acting on the defensive the Germans were almost invariably successful. In the case of the investments of Metz and Paris, the assailants as a rule had not the power of turning a flank, the investing lines being continuous; therefore they were compelled to attack in

front, and found themselves unable to break through the lines carefully fortified according to the principles already described.

But whenever there was a flank that could be turned, the embarrassment caused to the defence was most marked. At the time of the battle of Noisseville the line of investment round Metz was not complete. The position of the 1st division had an exposed flank at Noisseville. This village was captured late in the evening of the first day's battle, and its possession by the French endangered the whole position. But the superior energy of the Germans showed itself. Instead of waiting and preparing defensively to resist the attack that might be expected from this point, they stole a march upon the French and themselves attacked at early morn. Though not able to re-capture the village they reduced its occupants to the defensive, and when the attacks on the front of the position failed, the French retired from their post of vantage. We have seen how the fear of having his flank turned forced Von Werder to spread out his little force before Belfort, and the danger threatening his line from the capture of Chenebier averted by a vigorous offensive as at Noisseville.

On the whole then in this war we see exemplified, the frontal strength of a good position, the necessity for a clear field of fire, some of the main principles for the fortification of a field of battle, the conditions under which an attack may be expected to succeed, the way in which the strength of a position may be neutralized by its being turned either tactically or strategically, the way in which turning movements were guarded against and defeated in certain instances, and the way in which troops of superior quality are able to achieve success under circumstances where those of inferior quality would fail.

Russo-Turkish War of 1877.

We come lastly to the recent war between Russia and Turkey, and in it we have seen the use of Field Intrenchments carried to a very great extent. In the passes of the Balkans, on the banks of the Lom and of the Jantra, armies faced one another, each covered by works, and when fighting took place, as a rule, the assailants got the worst of it, except when they were able to outflank their enemies.

But the principal interest of the campaign centres round the defence and attack of Plevna; and about this episode we possess much fuller information than about any other, and therefore it is to the events happening round that place that it is proposed especially to call attention. It is unnecessary to recapitulate the well-known facts of its occupation by Osman Pacha, his successful resistance to the renewed Russian attacks, and his final sortie, defeat, and capture, but we will pass at once to the consideration of the characteristics of the position, whence its strength was derived, how it was that the Russian attacks failed, and the general lessons to be drawn from the episode.

The town of Plevna itself lies in the valley of a small stream running into the river Vid and is surrounded on all sides by heights on which the Turks established their defensive positions.

The following description is condensed from an article in the *Voiennyi Sbornik*, translated in the *Revue Militaire de l'Étranger*:—[1]

"The intrenched camp of Plevna was constituted of works raised by degrees. At "the time of the first Russian attacks on the 20th and 30th July, the position facing "north-east and east about Grivitza and the Tutchenitza ravine was alone fortified. On "the 12th September it was perceived that works had been erected on the heights of "Krichine, and lastly in the course of the months of September and October "the Turks raised a series of intrenchments on the heights of Opanets and "Blazigas. . . . .

"The number of the Turkish works, besides shelter-trenches and ways of commu- "nication, amounted to 60; they were arranged in groups, and formed to a certain "extent several separate intrenched camps.

"Thus, on the north of Plevna the plateau of Opanets was occupied by 11 redoubts "which mutually supported one another.

"Further on, on the crest of the heights of Bykovets, which follow the Grivitza "chaussée, there was established an intrenched camp about two versts in length, "surrounded by several closed works joined by trenches and reinforced by batteries "in the intervals. In front of this camp stood the two redoubts known as the "Grivitza redoubts. . . . .

"The space between the Grivitza chaussée and the Tutchenitza ravine was "defended by nine or ten works, disposed on three lines, and by a series of trenches. "The Turks had again nine redoubts on the heights of Krichine and the *Montagnes* "*Vertes*. Lastly the groups of fortifications of Blazigas facing the south consisted "of ten works, of which several were still unfinished on the 10th December. There "were besides, batteries and trenches constructed in the intervals. . . . . ."

The greater part of the works were quadrangular closed redoubts in the interior of which traverses in the form of a cross had been erected. The position of the works was chosen with much intelligence, though the square shape prevented them from sweeping effectually with their fire the ground in front. This disposition can only be explained on the supposition that they were intended to serve principally as points of support to enable troops to maintain themselves as long as possible in a certain position, while the ground in front was swept by musketry from trenches leaning on the redoubts and flanked by their lateral faces.

Redoubts (*See* Plate VI).—The redoubts had a strong profile, though the parapets were not high. They had deep ditches and the soil allowed the scarps to stand nearly vertical (Fig 1.)

An important feature in their plan was that they were very well traversed both on the faces likely to be exposed to enfilade fire and by a cross-shaped traverse in the centre of the interior space. The redoubts were generally armed with 2 to 6 guns firing en barbette between elevated bonnettes. When it was not intended to use the guns they were placed in excavations formed for the purpose behind the parapets or traverses.

For infantry fire there was a banquette, and a second line of fire was provided by a sort of covered way, and a third either from troops standing on a step in the escarp or in a trench on the glacis. (Fig. 2.)

Bombproof shelter was plentifully provided "either immediately "behind the parapets, under the banquette or barbettes, or behind the "traverses, in such a way as to avoid being reached by the enemy's "projectiles passing over the covering mass. The Turks had nothing

[1] "Revue Militaire de l'Étranger," No. 406, 8th June, 1878.

"to fear from vertical fire, as we only possessed four mortars. In some "redoubts the shelters were in the ditch and under the counterscarp; "but it was remarked that they were abandoned before the surrender "of Plevna, probably on account of the fire of our artillery."

As the bombproofs in the redoubts were insufficient for the whole garrison, they were specially reserved for the gunners, and the other soldiers were lodged in cover disposed in trenches dug at the sides and in rear of the works. The reserves were established in the same manner in trenches situated at a certain distance from the redoubts and connected with the latter by communications. Their bombproofs were either under the covering mass of the trenches or immediately behind it. (Figs. 3 and 4.)

The trenches had usually 2 or 3 ft. of height of parapet and about 3 ft. depth of trench, with a step for a banquette.

The Turks had also lodgments for tirailleurs, for a peloton or half peloton, 300 to 600 paces in front of the first line of trenches, and 18 to 20 paces in front of these lodgments circular excavations for single sentries, these holes being connected with the lodgments in rear by communications consisting of trenches or very narrow ditches.

General Todleben in a letter addressed to General Brialmont, the Belgian engineer, states the essential advantages of the Turkish entrenched camp to be:—

"1. The extent of the Turkish position round Plevna was nearly 36 kilometres.

"2. The configuration of the heights, which all starting from the town present a "fan of which Plevna is the centre. The reserves placed in this centre, at a distance "of 4 to 5 kilometres, could easily support all the menaced positions, whilst the "ravines which grew deeper as they approached the line of investment, intercepted "the communications between our positions.

"3. The fortifications presented several ranges of defensive lines practically "suited to the ground.

"4. The reserves could be placed out of range of our artillery.

"5. The scathing and ravaging fire of the Turkish infantry, which had never been "produced before by any European army."

He says also: "The fire of the infantry projected a hail of bullets to a distance "of more than 2 kilometres . . . . This arose from the fact that the Turks "did not take the trouble to aim; but, hidden in their trenches, loaded without "stopping. Each Turk had 100 cartridges on his person, and at his side a box of "500 cartridges. Only a few skilful marksmen aimed at the officers.

"The trenches were established in several tiers, the redoubts had on the most "important points three lines of fire:

"1, That of the rampart: 2, That of the covered way: and 3, That of the "scarp on a step in which the men hidden in the ditch mounted.

"The fire of the Turkish infantry thus produced the effect of a revolving machine "throwing incessantly masses of lead to great distances."

He says besides, that though the Turkish artillery fired at the range of 5 kilometres its effect was insignificant, as the shells rarely exploded.[1]

We will now turn to the way in which the position at Plevna was attacked by the Russians, and see what lessons can be drawn therefrom.

The first encounter between Osman Pasha and the Russians was in the open field. General Schilder-Schuldner sent from Nicopoli with

[1] "Revue Militaire de l'Étranger," No. 400, 27th April, 1878.

three regiments 18 sotnias of Cossacks, and 46 guns, not more than 9,000 men in all, to occupy Plevna, found that place in the possession of Osman Pasha, attacked him and was defeated by the great numerical superiority of the Turks.

Then General Krudener was ordered up with his corps and certain reinforcements, and on the 30th July an attack was made on the Turkish position, which meanwhile had been strengthened as already described.[1]

The arrangements for the attack were as follows: A detachment of cavalry was to guard the right flank.

The right wing under General Veliaminoff, consisting of the 31st and 5th infantry divisions, together 18 battalions and 80 guns, and 3 squadrons, was to attack the Turkish position north of the Grivitza chaussée.

The left wing under Prince Schakovsky, consisting of a brigade of the 30th and a brigade of the 32nd divisions, 12 battalions and 48 guns, and 2 squadrons, was to attack the position south of the chaussée.

A left flanking detachment under General Skobeleff, consisting of 12 sotnias of Cossacks, an infantry battalion detached from Schakovsky's force and 16 guns, was to place itself on the road leading from Lovtcha to Plevna to prevent any interference in the battle from the side of Lovtcha.

The general reserve consisted of a brigade of the 30th division, 6 battalions, with 2 squadrons and 30 guns.

The right wing completed its assembly before the hostile position about 7 A.M. on the 30th July. There was a thick fog at the time, so that the Russians could see nothing in front of them but a broad ravine covered with bushes and on the near side skirmishers of the enemy and 2 guns. By 9 o'clock, however, the fog had so far thinned that the Grivitza redoubt could be seen, and on it 40 guns, the most that the locality permitted the Russians to bring into action, directed their fire. This artillery action continued till 2.40 P.M.

At that hour General Krudener gave the order to General Veliaminoff to proceed to the attack, which was directed against the Grivitza redoubt in two columns, the right consisting of the Penza regiment and the 2nd and 3rd battalions of the Koslov regiment, 5 battalions in all, and the left consisting of the 1st battalion Koslov, and the Tambov regiment, 4 battalions in all. The regiments Archangel and Vologda (6 battalions) followed the right column as reserve, the regiment Galitz (3 battalions) the left.

The 1st battalion Penza formed the head of the right column, and captured a row of trenches lying on the near side of the ravine, but was brought to a standstill by the murderous fire from a second row also on the hither side of the ravine. Then the 2nd battalion, coming up on the left of the 1st, took the second row of trenches, and crossed with the fleeing Turks the ravine lying between the captured trenches and the redoubt and pressed on towards the redoubt itself. A third row of trenches lying in front of the redoubt was taken, the captors

[1] Thilo von Trotha, "Der Kampf um Plevna." p. 36 *sqq.*

settled themselves in it and part of them tried from thence to take the redoubt itself. But the commander of the 2nd battalion was killed and the attack beaten off. All attempts also of the other two battalions to take the redoubt failed, and when the regiment had lost, under the murderous rifle fire from the redoubt itself and from its flanking trenches, 29 officers and 1,000 men, it fell back entirely disorganized.

Then the two battalions of the Koslov regiment that belonged to this column advanced and in part reached the ditch of the redoubt. Here the commander of the regiment fell, and the assailants failed to capture the parapet, but established themselves in the ditch.

Then General Schilder-Schuldner led forward the regiments Archangel and Vologda. These captured the trenches lying to the side of the redoubt, from which the attack of the Koslov regiment had been taken in flank, but the attack even of these six fresh battalions against the redoubt remained unavailing.

The left column met with no greater success, and about 6 P.M., when the infantry fight had already lasted more than 3 hours, the state of the case was this: The three battalions of the Penza regiment had, as it appears, withdrawn entirely from the fight; the remnants of 15 other battalions, sorely punished by the enemy's fire, maintained themselves in considerable dislocation on the ground between the redoubt and the ravine.

General Krudener, in hopes of turning the scale, sent at different times almost the whole of his reserve into the action and ordered about sunset a renewed assault. But this, three times delivered, was beaten off, and he then withdrew his sheltered troops from the hopeless contest.

On the left wing also the fight commenced by an artillery action, which began about 10 A.M. and lasted till 2.30 P.M., when Prince Schakovsky gave the order for attack. Two regiments then, the Kursk and Rylsk (5 battalions), moved against the two redoubts lying between the chaussées to Bulgareni and Lovtcha, in front of which lay a threefold and in part fourfold system of shelter-trenches. After an obstinate fight the trenches were captured and the Turks thrown back on the redoubts. The two regiments then moved forward to storm the redoubts. The eastern one was captured by the Rylsk regiment after comparatively a short struggle; two guns fell into the hands of the Russians while 10 more were withdrawn by the Turks.

The Kursk regiment had greater difficulties to encounter in taking the western redoubt. Their unprotected left flank was exposed to the fire of a battery that came into action on the edge of the Tutchenitza ravine and of the swarms of skirmishers ensconced in the ravine, while at the same time in front on either side of the redoubt, thick closed lines of infantry rose up, which commenced a murderous fire about 200 to 300 paces from the stormers. To support the attack a company of the Rylsk regiment moved out of the already captured eastern redoubt, while a battalion of the Schouia regiment from the reserve was drawn forward to the left flank of the attacking regiment, while at the same time *the artillery of the left wing strengthened by a fresh battery drawn from*

the reserve advanced towards the redoubt. The attack succeeded, though the loss was great.

But Turkish reserves began to press heavily on the Russians in the position they had won, and Prince Schakovsky was obliged to employ his reserves in maintaining his position. A regiment sent by Krudener from the general reserve never reached the Prince, and eventually as night came on and he had no further reserve, he was compelled to give up the advantage he had gained and fall back again to Radichevo.

Attack on Lovtcha.—The successful attack on Lovtcha by General Skobeleff on the 22nd of August presents several points of interest, especially as they have been critically considered by Captain Kouropatkine, General Skobeleff's aide-de-camp and right-hand man.[1]

On the 20th and 21st August, a line of heights opposite the Turkish position before Lovtcha were occupied by the Russians, who intrenched themselves and erected batteries for 56 pieces.

In anticipation of the attack General Skobeleff issued to the troops a remarkable order, in which he says:—

"The principal rôle, in the first period of the combat which is about to take place, "belongs to the artillery. The order of the attack will be communicated to com- "manders of batteries, who are recommended not to disperse their fire. When the "infantry advance to the attack, they are to be supported by the whole power of fire. "The greatest attention is necessary; the fire is redoubled when the adversary "presents his reserves and attains its last limits when the attacking troops are "arrested by an unexpected obstacle."

"When distance permits, shrapnel is to be fired against trenches and troops."

To the infantry General Skobeleff says, that disorder must be avoided, that the march to the attack must not be confounded with the charge, the sacred duty is not to be forgotten of supporting comrades at all costs and no matter how.

Ammunition must not be wasted; the supply is rendered difficult by the ground. Order and silence are most important. Hurrah! should not be shouted except when the enemy is actually within reach.

At 5.30 A.M. on the 22nd August, the action was begun by a preparatory fire from the 56 pieces placed in battery. General Skobeleff's report says:—

"The enemy replied to our 56 pieces and did it with success, thanks to the range "and accuracy of his guns, superior in those points to ours. For instance, the 4 "pieces of 9 installed in the battery 'Prince Imeretinsky' could not, in spite of the "energy and skill of their chief, reduce to silence a hostile battery of 2 pieces that "was opposed to them." On the other hand, "The action of our artillery against "the infantry lodged in the epaulments of the 'Montagne Rousse' and the heights "Nos. 2, 3, and 4 was very murderous. The preparatory fire lasted from 5.30 A.M. "till 2 P.M. when at last your Excellency gave the signal for attack. The very "small losses suffered by our columns, whilst they moved to the assault of the "enemy's first line, show how useful, in the present war against the Turks, was the "fire of our artillery and how important is the period of preparation by artillery "for every attack directed against fortified and armed positions."

This opinion is worth noting, as the idea is very wide-spread that

[1] For account of action and Kouropatkine's notes in full, see "Revue Militaire de "l'Etranger," No. 385, 12 January, 1878.

the artillery played but a small part in the late war. Even about this very attack on Lovtcha, a correspondent of the *Times* in the issue of March 20th, 1878, wrote :—

"At Lovtcha I saw fifty pieces of artillery concentrate their fire on the great re-
"doubt for two and a half hours, and not a Turk left his place behind the parapets,
"or in the outlying infantry trenches." "The Russian practice was good, the
"earthen walls were struck in all directions. I saw the shell holes after the work
"was captured, but no effect was produced upon the garrison, and I found only one
"dead man, who had evidently been killed by a shell. The inevitable conclusion is
"that the Russian shells fired at Nikopol and Lovtcha were simply wasted."[1]

When doctors differ, who shall decide? Perhaps the real truth is that whilst the artillery fire was going on, the Turks did not indeed leave their works but took refuge to a great extent in the shelters with which they were so plentifully provided. Their loss therefore would be trifling, but in cases where, as at Lovtcha, the artillery according to Skobeleff's orders kept up, nay intensified, its fire when the infantry advanced, the fire of the Turks would be also trifling, and hence the Russian loss small, as reported by Skobeleff. When, however, as occurred in certain other instances, the Russian artillery fire ceased when the infantry moved to the attack, then the Turks came out again from their shelters, and manned their parapets with unshaken resolution and the Russians found their preparatory artillery fire of little use.

Hence it would seem as if a long preparatory fire of artillery against earthworks of strong profile, well provided with bombproof cover, would be of little use, but that it may be of very great use if kept up with vigour whilst the infantry are actually advancing to the attack.

After this preparatory artillery fire the Russian infantry advanced "as at drill, with bands playing and colours flying" and captured the Turkish position in front of Lovtcha, and the town itself. Then batteries were brought up to this position to shell the last position of the Turks, the redoubts and trenches on the hill behind the town on the left bank of the Osma. Eventually this position also was captured.

Captain Kouropatkine's notes are too long to be quoted here *in extenso*, but some of the principal points may be noticed.

He says, the Russian infantry frequently advanced with the chains of skirmishers too thick and the supports too near, causing unnecessary loss.

The want of a sufficiency of intrenching tools was severely felt.

In the town of Lovtcha disorder spread rapidly through the infantry. Instead of occupying the edge of the town, and choosing positions from which they could reply with advantage to the fire of the enemy, companies and single men massed themselves in the street, by ranks, pressed close to the houses, or lay down in the ditches.

The enemy's fire caused considerable loss to the Russians even at a distance of 2,000 paces, thanks to the enormous quantity of cartridges fired.

[1] On Intrenchments, Major-Gen. Bainbrigge, R.E. Papers of R.E. Institute, vol. ii, No. 6.

Nothing is more difficult than to keep in hand troops entering by force into a town.

In the attack on the heights beyond Lovtcha an open space had to be traversed by a part of the force beyond which a mill and a few trees gave some cover. Part of the men crossed the open space in one rush; others, taking advantage of heaps of stone left by floods, lay down behind them so that there were formed in some places compact groups of soldiers lying down.

But these heaps gave but a poor protection from the enemy's fire. The most courageous jumped up and ran forward, followed by their companions. About half an hour after the commencement of the offensive movement, the mill and its surroundings was occupied by some hundreds of men, the number continually increasing, and the cover began to prove insufficient. Then the officers tried to initiate a further forward movement, but the men, who had not yet recovered their breath, did not respond to the call.

At last they got their wind again, and were ready to recommence their forward movement.

First, a few brave men accompanied by an officer made a bound forward for 50 or 60 paces; some got cover behind trees, others threw themselves on the ground. The impulse was given; gradually the mill was deserted, the men leaving by groups or singly.

The men who thus advanced were supported on either side, and could see troops everywhere to give them assistance, and their spirits rose.

To the surprise of all, the fire of the Turks did not increase in efficacy as they got nearer. It became clear that the enemy began to be shaken. Suddenly the Turks abandoned their works and began to flee without waiting for the charge of the Russians.

This sketch of the progress of the attack is most instructive. We see how cover is utilized to obtain a rest during an advance under fire, and how difficult that advance must be if no shelter of any kind can be obtained. We also see the efforts of the officers unavailing to get men forward who are still exhausted by a previous effort, but how gradually the spirit of enterprise returns and can be taken advantage of by watchful and chivalrous officers. Again, the encouragement given to men by seeing themselves supported is shown, and therefore the importance of making arrangements for the continual support of troops engaged in a serious attack. Finally we see a weak point in the Turkish soldiery, which sometimes shows itself, namely, that of losing *morale* when fairly tackled and their habit of being too careful in covering themselves with their parapets, so that they do not put up their heads to take aim, but fire without aiming, a result of which is, that firing an enormous number of cartridges, they cover a large space with a hail of bullets, but when the assailant approaches, their fire is less deadly, many shots going over his head.

Skobeleff's Attack in the Third Battle of Plevna.

Third Battle of Plevna.—We will now take a glance at the attack made by Skobeleff on the redoubts to the south of Plevna during the

3rd battle, 11th and 12th September. The facts are taken from General Skobeleff's report to the Commander of the Army of the West, translated in the "Revue Militaire de l'Étranger."[1]

On the 8th September, General Skobeleff commanding the first echelon of the detachment of Prince Imeretinsky, took possession of the 2nd crest of the "Montagnes Vertes," south of Plevna. (*Vide* Map).[2]

The next morning Skobeleff heard that the general assault was postponed for a day, so he fell back to a strong position on the 1st crest between the Tutchenitsa ravine and Brestowets. "When it "was organized it presented two ranges of deep trenches with an "excellent field of fire formed in front of them by a sort of espla- "nade."

The 9th, the Turks made several attacks on this position, but were repulsed, and Skobeleff received orders to attack the next day the heights that commanded Plevna on the south.

The next day, the 10th, the Russians again took possession of the 2nd crest after a slight musketry engagement, and fortified it. Skobeleff decided not to attack the 3rd crest that day, so as not to engage the troops in unequal fight before the general attack.

"A serious cause of these delays in attacking was the evident "necessity of fortifying by works the positions captured," and Skobeleff complains of the want of Engineer Officers and Sappers, and of the tendency of the Russian soldiery to throw away their intrenching tools.

In this position, on the 2nd crest, the Russians received two attacks during the night of the 10th September, but being made without vigour they were easily repulsed. During the night Skobeleff received orders that the general attack was to be made the next day, and he was given the command of a special detachment of two brigades and a regiment of infantry and 4 batteries (8 guns each).

On the 11th September, General Skobeleff's detachment had to capture the 3rd and last crest of the Montagnes Vertes, and then to attack the redoubts and lines of intrenchment beyond, covering the Turkish camp. The attack was to commence at 3 P.M., and the rest of Prince Imeretinsky's detachment was to be in reserve.

At 10 A.M., the Vladimir regiment formed on two lines of company columns, with the 10th Chasseurs on the right and 3 companies of the Esthonia regiment on its left flank, and three batteries in reserve commenced its movement against the 3rd crest. The first line hardly answered the sharp fire of the Turks covered behind their epaulments and arrived in order on the named heights, when it endeavoured to cover itself as much as possible, profiting by very soft ground and high fields of maize. Installed there it opened fire. The Turks seeing the Russian advance stop, took the offensive in force. A hot fire ensued from 11 A.M. till 2 P.M. The Russians could only hold their

[1] "Revue Militaire de l'Etranger," No. 390, 16th Feb. 1878, and 388, 2nd Feb., 1878.

[2] See plan of Plevna in Major Fraser's Essay, Plate XI.—Ed.

positions by covering their first line by shelter trenches, and choosing a well-defiladed position for the reserves. The whole of the 1st line (Vladimir regiment) gradually entered into action and Skobeleff was obliged to draw the Souzdal regiment from the reserve and place it behind the Vladimir.

About 2 P.M. the line of Turkish tirailleurs had approached so near as to cause sensible losses not only to the first Russian line but also to the reserves, and Skobeleff considered it impossible to remain longer inactive; so as the hour of the general attack was approaching, he ordered the Souzdal regiment to take the offensive. The Turks did not hold their ground but retreated to their intrenchments.

Then Skobeleff brought up to the fighting line, besides the regiments of Vladimir and Souzdal, and the 9th and 10th battalions of Chasseurs already engaged, the Revel regiment, and placed it in the valley behind the 3rd crest. The Liebau regiment and 11th and 12th Chasseurs were placed behind the 2nd crest. Two battalions of the Kalouga regiment and 2 of the Esthonia regiment remained in the fortified position on the 2nd crest, and a battalion of Kalouga occupied Brestowets. Three batteries were in action on the 2nd crest.

At 3 P.M. the order was given to attack the redoubts. The fighting line rose and advanced, bands playing and drums beating. "The "Turkish intrenchments consisted of two redoubts of strong profile, "provided with traverses and connected by deep trenches, and of "lodgments or shelters for tirailleurs dug in front of the redoubts on "the slopes of the plateaux."

The attacking troops had to pass a valley or ravine in which was a stream with scarped banks. They were received with a very heavy fire of musketry and artillery from the lodgments and redoubts attacked, and also from the Krichiné redoubt on the left. The first line stopped on reaching the stream, and only a strong line of skirmishers was able to advance further, approach the open slopes, lie down on the ground and open fire, with little effect, against the well-protected Turks. (The Russians had first to descend the wooded and vineclad slopes of the 3rd crest to reach the stream, and beyond it to cross a steep and perfectly bare slope of some 700 yards leading up to the Turkish works.)

Skobeleff then ordered the Revel regiment to support the attack, and his last reserve, the Liebau regiment and 11th and 12th Chasseur battalions, to advance and replace the Revel regiment. The Revel regiment advanced to the attack as if on the drill-ground, crossed the stream and moved up the slope, dragging with it parts of the Vladimir and Souzdal regiments; but they could not sustain the enemy's fire. The Revel regiment stopped half way up the slope, and those portions of the Vladimir and Souzdal Regiments and of the 9th and 10th Chasseurs which had remained near the stream began to dissolve and dribble to the rear. "The moment was critical. It was necessary "to choose between two alternatives, either without losing a minute "to throw forward the last reserves and break the resistance of the "enemy with all the forces brought into first line, or, as the attack

" of the 4th corps (next on the right) had been repulsed, to engage " part of the reserve and under its protection draw back the troops " engaged."

Skobeleff chose the first alternative, brought up 12 fresh companies of the Liebau regiment and the 11th and 12th Chasseurs, and with them carried forward the troops already engaged to the attack of redoubt No. 1.

On arriving at the first lodgments they threw themselves, headed by Skobeleff himself, into them with shouts. The Turks fled towards the redoubt. This first success encouraged the assailants; they advanced, not with closed ranks, but in groups, the bravest and most active in front; the enemy's fire as they advanced got less and less accurate, and wavering showed itself in his ranks. A last effort and the Russians threw themselves into the trenches and a few minutes later, at 4.25 P.M., into redoubt No. 1.

Their position was, however, critical; the men in the trenches joining redoubts No. 1 and No. 2 were exposed to the fire of the latter, and the gorge of No. 1 was open to the side of the Krichiné redoubt. Artillery from this redoubt caused great loss, and Turkish infantry also advanced from that direction, but Russian soldiers who had straggled kept coming up, and a successful effort was made to collect some 300 men and to lead them forward towards Krichiné. Being continually reinforced, they succeeded in repulsing the Turks on that side about 5.30 P.M. The Russians could then have covered themselves if they had had any intrenching tools.

Meanwhile, Prince Imeretinsky had not been idle, he had collected and reorganized the men who had fallen back, and with a few fresh companies led them forward again, and about 5.30 P.M. captured redoubt No. 2.

The Turks still held Krichiné and its redoubt, and the attack of the 4th corps had failed, so Skobeleff's men were thrust like a wedge into the Turkish position, and exposed on three sides.

The Russians worked hard to cover themselves and replenish ammunition, &c., under great difficulties. Skobeleff succeeded in getting four guns into redoubt No. 1, to the great joy of its defenders, and maintained himself in the position he had won, all night and all next day, in spite of the attacks directed on him. But no assistance reached him, and no diversion elsewhere prevented the whole Turkish strength from being hurled against him, and towards evening, on the 12th, he was at last forced out of the position he had held so long, and which, with proper arrangements, might have been used as a lever to upset the whole Turkish scheme of defence.

Remarks.—In considering this episode it is difficult to understand why the Vladimir regiment was pushed forward to the 3rd crest so long before the general attack was to begin. There is no sign of any apprehension lest it should be occupied in force by the Turks; but when it was occupied by the Russians, and their advance stopped there, counter-attacks by the Turks were provoked, which necessitated the premature employment by Skobeleff of part of his reserve.

The attack on the Turkish intrenchments was conducted by Sko-

beleff with greater skill than had been shown in former attacks on Plevna. He always was ready to send fresh troops to give a new impetus to the advance when it flagged, and thus, and by his personal example, he was able to carry his men through to the Turkish works; but there appears to have been, even here, a tendency to try and advance too much in closed bodies without firing, instead of pressing on a gradually strengthening line of skirmishers, and the support of the artillery does not seem to have been very efficient.

The Turkish counter-attacks were always brought to a standstill some distance off by the Russian fire, and they could never be induced to advance again, but after remaining stationary for some time, began to retreat.

Especially noteworthy is the stress laid by Skobeleff on the necessity of fortifying positions won, and his complaint of the insufficiency of technical troops, and of the habit of the Russian soldier of throwing away the intrenching tool he carries.

General Remarks on the Experiences of the Russo-Turkish War.

In this war we see great use of intrenchments, and attacks made on intrenched positions generally repulsed. But the attacks were usually conducted by the Russians in a manner unsuited to the present weapons.

Captain von Trotha remarks:—"As is sufficiently evident from the description of "the several actions, there is scarcely any preparation for or commencement of the "attack by infantry fire; this preparation is usually left to the artillery.

"The attack, begun generally at a great distance (1,000 paces and more), is usually "carried out in this way, that the chain of skirmishers and two lines of company "columns, often also at the same time the reserve formed in battalion masses, enter "the fight almost at the same time with comparatively small distance between them, "and get dislocated in the advance, so that the attack under the most favourable "circumstances reaches the enemy in a very irregular swarm.[1]

"If the first rush does not bring the attacking troops up to the hostile position, "they settle themselves on the ground and begin a lively but generally little effective "fire; the tactical order is then to the highest degree loosened and the tactical "leading made very difficult, if not impossible; in order to bring the line that has "thus come to a halt again into motion, it requires generally fresh troops sent for-"ward from the reserves."

"The attacks are almost always directed against the front of the enemy's position, "attempts are seldom made to turn either one or both flanks of the enemy."[1]

Whenever the attacks were carried out at all in a suitable manner by the Russians, they succeeded. It is not, therefore, universally true that their intrenchments enabled the Turks, the inferior troops, to hold their own against the better troops of the Russians. This was only the case when the Russian attacks were made in a manner from which failure might *à priori* have been predicted.

The question of the value of artillery fire is left undecided, as evidence can be produced on both sides.

The desirability of some arrangement by which troops should always have at hand an adequate supply of intrenching tools comes

[1] Thilo von Trotha. "Der Kampf um Plevna," p. 158.

prominently forward, as they are required as much for the attack as for the defence.

Deductions as to the Conduct of Tactics in the Future.

We now arrive at the second part of our inquiry, viz., the deductions that may be drawn from the review we have made of recent campaigns, as to the proper conduct of Tactics in the future.

Let us first consider the value of a defensive position under present conditions.

Our analysis of modern experience will show us when attacks are not likely to succeed, viz.:—

(*a.*) When made by raw troops; when the assailant's artillery is not good enough, or not well enough handled, to overpower that of the defender, and when the infantry, from want of training, cannot trust itself to open-order fighting, but must move in masses; in such a case, as in the battles before Belfort, and in the sorties from Paris, the attack will probably fail, even if made with greatly superior numbers.

(*b.*) When the attack, though made by troops of superior quality to the defenders, is carried out in an unsuitable manner, as at Plevna, where the Russians usually attacked in closed bodies, and the fire neither of their artillery nor infantry was effective in subduing that of the Turks.

(*c.*) When made, even with superior troops, on correct principles and in superior numbers, if the defenders have a clear field of fire, and are well covered, and the assailants cannot bring up an overwhelming artillery mass to concentrate its fire on some well-defined decisive point to prepare the way for, and support the infantry attack; as along the greater part of the line of battle at Gravelotte, and commonly in the American War.

Under any of these circumstances the defence will probably prove successful.

But we cannot admit that an intrenched position is now absolutely unassailable, and still less that—

> "Men with stout hearts and good rifles, even if they are but roughly drilled, can "be trusted to hold their own," or that "the use of earthworks enables less "highly drilled infantry and less perfectly trained artillery to do as good work as "older and more perfectly disciplined troops," and "our volunteers are as far ahead "in drill and discipline of the Turkish troops, whose conduct has astonished the "world, as our regiments of Guards are ahead of our Militia, and with the advantage of shelter trenches might be trusted to defend a position against the best "troops in Europe."[1]

Let us look into the matter. We find that the Germans always managed to drive the French back whenever they could obtain any cover, as in the woods at Spicheren, the fighting in the vineyards and orchards at Woerth, and the attack on St. Hubert at Gravelotte. In the battle of Noisseville also, the French succeeded in forcing back the German line of guns before Servigny, and capturing, and holding for a

[1] "Lessons of the War," Standard, February 1878.

time, that village, by creeping along the vine-clad slopes of the valley south of the village, where they were partially protected from the defenders' fire. Therefore, wherever the fire of the defenders is not fully effective, there the assailants have a chance of advancing, and there are few positions which will not afford some cover somewhere, and therefore give the assailants some chance if they know how to make use of it. But further, we see in the case of St. Privat, that an overwhelming concentration of artillery fire was able to render the defenders' fire so imperfectly effective as to enable the infantry to attack with success, although the ground was quite open. Therefore, again, an attack has a chance of success if the assailants' fire can sufficiently quench that of the defenders. Thus it appears that an attack may be delivered with a fair chance of success wherever the assailants can be saved from the full effect of the defenders' fire, either by cover given by the accidents of the terrain or by the quenching of the fire of the defence by that of the attack.

The question now arises, whether by a proper preparation of the ground, and use of intrenchments, the defenders may deprive the assailants of both of these chances of success.

If sufficient time is available, all cover can no doubt be cleared away. All brushwood, walls, hedges, trees, &c., that can afford cover, may be removed, and inequalities in the ground levelled, and trenches and batteries so disposed as to sweep every yard of ground over which the assailant can advance. But it must be remembered, that except in an unusually good position, such as that of Gravelotte, to do this will be a work not of hours, but of days.

We have to consider further, whether it is possible to prevent the quenching of the defenders' fire by that of the attack. In many cases if the defensive position be well chosen, the space available for the assailant to bring up guns to prepare the way for the attack will be limited and clearly recognisable by the defence. At Gravelotte, for instance, woods in the German centre and right limited their artillery positions to the ground adjacent to the village of Gravelotte and that between the woods of Genivaux and La Cusse. In the Russian attack on the Grivitza redoubt, on the 30th July, the ground only permitted 40 guns to be brought into action. Whenever the assailants' artillery positions are thus limited, the defenders ought to be able so to arrange their own batteries as to prevent those of the assailant from obtaining a superiority, and in such a case, if the defenders' field of fire is open enough to prevent skirmishers from stealing up to annoy their artillery, the defence ought to have the best of it.

But can such a catastrophe as that of St. Privat be guarded against? Here nothing prevented the concentration of an unlimited number of guns, and the result was the fall of St. Privat and the compromising of the whole French position. But St. Privat was an open village and therefore liable to great damage from artillery fire: would properly constructed earthworks be able to hold out against such a fire? Judging from the example of Plevna many would answer that question in the affirmative, but surely the verdict ought still to be "Not proven." It is no doubt stated that the Russian fire produced no effect in ren-

dering the Turkish works untenable, but then was it properly used? The point is, to say the least of it, doubtful. General Todleben in his letter to General Brialmont says:—

"The salvoes of our batteries concentrated unexpectedly, sometimes on one redoubt, "sometimes on another, seemed at first to produce a great moral impression upon "the enemy, but soon they only succeeded in stopping the works during the day. "The enemy was not slow in taking his measures; the garrisons of the redoubts "were withdrawn and placed in trenches at a certain distance from these works; "the deep and narrow ditches were alone occupied by the Turks. It is unnecessary "to say that against the trenches and ditches our artillery found itself power-"less."[1]

Now this is decidedly not the way to employ artillery if it is wished to attack with success. There must be no cessation, no giving time to the defenders to recover, but the fire must be kept up without intermission till the moment of assault. In the first place the fire of the defenders' artillery must be subdued to a great extent if not entirely silenced. Then the infantry of the attack can gradually push forwards in open order and by its fire help the artillery in keeping down the infantry fire of the defence. For this purpose the fire of the shooting line must never cease entirely, but whenever it and the artillery produce a lull anywhere in the enemy's fire, part of the line may make a forward rush and lie down again and open fire to help the advance of some other portion; thus bit by bit the line gradually gets within reach of a rush at the position to be taken, the defenders' fire being kept down by the part of the line not in motion at any particular time.

The question is whether the fire of troops protected by earthworks can be so kept down as to permit of advance. Plevna ought not to be taken as proof positive that it cannot. Todleben indeed says that against trenches and ditches the Russian artillery proved ineffective, but Skobeleff, on the other hand we have seen, speaks strongly of the way in which the artillery facilitated the advance of the infantry. Therefore we ought not to conclude too hastily that artillery is of no use against earthworks. At all events, as already suggested, fire with shrapnel may be able to prevent the defenders from showing their noses over their parapets, even if it cannot actually reach them in their cover, and if they cannot see to aim, their fire cannot be absolutely prohibitory to the advance of the assailants even if they fire away as many cartridges as the Turks did. And if the artillery advances so as to be able to keep up its fire to the moment of assault, the attack may be crowned with success.

Further experiments as to the efficiency of artillery fire against intrenchments are much to be wished for, and it may be found that it is desirable to arm a portion of our field artillery with a weapon more particularly calculated to throw projectiles that will produce a considerable effect upon earthworks, than is the especially man-slaying weapon that we have recently been employed in designing.

In short we would submit that it is not yet proved that by means of superior artillery an assault may not be given with success against a

[1] "Revue Militaire de l'Etranger," No 400, 27th April, 1878.

position even if defended with earthworks, unless the defenders have had so much time to prepare as to have been able to throw up works of a very strong character with a second line so far removed that a fresh preparation is needed before assaulting it. If this has been done, the position has assumed the character of a regular fortress and like it cannot be taken by assault, but must be approached by works resembling those of a siege.

And we see, even in the case of the Russo-Turkish war, that wherever an attack was delivered by the Russians in anything like the proper way, it was successful. Witness Skobeleff's capture of Lovtcha, his attack on the redoubts on the 11th September, and Schakovsky's attack on the 30th July, although in the two latter cases the advantage temporarily gained was lost again through the faulty general arrangements, by which no reserve was available to reap the fruits of any success.

But although we may not have reason to accept the proposition that intrenchments such as can be thrown up in the ordinary time available for the preparation of a field of battle, will render a position *impregnable*, yet we must fully admit that their judicious use will render an attack difficult and costly, if not hazardous. Let us then examine what would probably be the best course for a General acting on the offensive to pursue if confronted by an enemy in an intrenched position.

As regards this point we learn a lesson from Sherman's operations in the Atlanta campaign, and Lee's in Virginia. Sherman was continually met by Johnston posted behind intrenchments, which he could not assail with success, but he dislodged Johnston from one position after another by operating round his flank so as to threaten his communications. Sherman was greatly superior in numbers, and therefore, while securing his own communications by intrenching a part of his army in Johnston's front, he was able to send round his enemy's flank a force large enough to be quite safe, even if Johnston could fall upon it whilst detached. Such an operation will always be practicable when the army operating on the offensive has a considerable superiority either in numbers, as in the case of Sherman, or in quality of troops, as in the case of Lee after the second battle of Bull Run.

Therefore we may at once discard the allegation that inferior troops "with the aid of shelter trenches could hold a position against "the best troops in Europe," so long at least as the position can be turned. This point has been well disposed of in an able article on the Lessons of the War, in the *Saturday Review* of Feb. 23rd, 1878.

But operations such as Sherman's brought no destruction to his enemy's army, they only caused the evacuation of territory. Under some circumstances that may be all that is required, but generally the invader wishes to bring his adversary to decisive action, so that he may destroy his field armies and prevent them from gradually gaining strength as they fall back, when they may in the end obtain a superiority. In such cases Lee's method of action before Chancellorsville would be preferable. He did not remain quietly in his intrenchments

while sending a force round Hooker's flank, but kept up a series of attacks and demonstrations to hold fast his enemy, while Jackson was turning his flank. Thus the enemy had no chance of escape. He was pinned to his position by the front attack while the flank movement was in progress, which, when it burst upon him, inflicted severe defeat.

This method of operating has another advantage. It may be possible to guard against a tactical turning movement within the limits of the battle-field itself by a judicious use of intrenchments and a proper disposition of troops; but a wide turning movement out of sight and range of the position occupied by an army and directed against its communications, can only be defeated by counter-manœuvres and throwing a superior force on the turning body and crushing it whilst separated from the remainder of its army. If now the part of the invading army in front of the defenders' position contents itself with remaining behind intrenchments and only prepares to resist an attack, the defenders have the opportunity of leaving a small force only to keep up the appearance of holding the position, while directing the bulk of their strength against the turning force, obtaining thereby the best chance they could have of crushing it. But if attacks are continually directed on the position the defenders cannot withdraw large forces without leaving weak points which will be detected and taken advantage of, and therefore the turning force will be secured and enabled to make its movement with safety and precision. Moreover, if the General of the defending army determines not to hold his position, but to retreat, he will be much delayed by the attacks on what will then be his rear, and may possibly not be able to get away fast enough to escape from the danger with which the turning force threatens his flank.

A General confident in the superiority of the fighting and manœuvring power of his men over the enemy can operate in this way without anxiety. Even if he does not consider himself strong enough to divide his force, he may move his army bodily round the flank of his enemy, leaving only a very small number of troops in some strong position on his line of communications to guard his most advanced magazines for a time at all events, like the position of Allatoona which Sherman left protected by a small force, whilst with the rest of his army he struck for the Chattahoochee. The most serious danger that would be run would be if the defenders left their position to attack either the army on its flank march or the small force covering the magazines. But this is just what the General of the invading army should desire; by the conditions of the case he is superior in fighting and manœuvring power, and his greatest wish should be to get his enemy to fight him in the open. And if the arrangements be properly made the risk run should be small. The power modern weapons certainly give to small bodies of holding out defensively for a certain time even against greatly superior numbers ought to give security to the flank march, if a covering force moves between the enemy and the main body, for if attacked this covering force ought to be able to check the enemy long enough for the main body to form for battle, when the

result should not be doubtful. And in the same way the small force covering the magazines properly intrenched should be able to hold its own till the main body, which would quickly learn the enemy's movements, could turn back to its assistance and probably catch the enemy between two fires.

It might be necessary for the invading General to cut himself off temporarily from his communications in order to make his flank movement, confident of being able to regain them either by the retreat of the enemy or his defeat if he ventures to give battle.

Intrenchments therefore will not make up for inferiority in quality of troops, or in numbers if the quality is the same on both sides, if the position can be turned.

A General acting on the offensive will therefore on encountering an enemy in position, ask himself: can this position be turned? and if it can, will it be best for me to try and turn it, or run the risk of attacking it?

If the position can be turned the answer would no doubt be always that it would be best to turn it, were it not for the consideration that in so operating there is always a chance that the enemy *may* escape without being brought to a decisive action. When, therefore, a General wishes above all things to bring his enemy to action and the circumstances of the case are such that the enemy by retreating can reach some place of safety, as in the case of a position in front of an intrenched camp, or effect a junction with another army, then the General will have to accept the risk of an attack upon the position. But if in falling back the enemy has some considerable distance to traverse before reaching a place of safety or being reinforced, then the General of the advancing army, if he has reason to believe the position to be strongly fortified, will probably manœuvre the enemy out of it, in hopes of fighting him in the open if the enemy tries to take the offensive in his turn, or is caught in his retreat; or if the enemy succeeds in effecting his retreat from the first position, he will be able to follow him and bring him to bay before he can reach a place of safety or aid, and can attack any fresh position that may be taken up before it can be so fortified as to preclude all chance of the attack being successful, for it is very rarely indeed that a position can be found so perfect that one or two days' work should suffice to eliminate every weak point in it.

Therefore a General possessing a superiority over his enemy, either in his own genius, in the quality of his troops, or in numbers if the quality of the two armies is equal, will in most cases be able eventually to fight his enemy on his own terms, and intrenchments will *not*, except under unusual circumstances, atone for inferiority.

Attack of a Position.

But although as a rule a General would hesitate before attacking a position believed to be intrenched, yet at some time or other it may be necessary so to do, and we must now try and see how this may best be done.

From what has been already said it is evident in the first place that

an attack has little chance of success if delivered where the defenders' fire has full play. Therefore the first thing to be done is to select some point for the main attack where the effect of the defenders' fire can be to some extent escaped from, either by making use of cover afforded by the ground, or by subduing its intensity by your own superior fire, or in both ways. Careful reconnaissance will generally discover some part of the defensive position which can be approached to some extent under cover or against which a powerful converging fire can be brought. To the flanks especially should attention be directed, if possible to outflank the position and get in rear of it. For this purpose parts of the line may be weakened with much less risk than in former times. It was very dangerous to extend the line of battle too much to try and outflank the enemy, for a vigilant opponent might discover a dangerous weakening of some point, and taking the offensive might break through it. But in these days lines of battle are necessarily formed so far apart, that it is very difficult to detect a weak place, and a General will hesitate to leave his strong position to attack some point which after all may be stronger than he thinks. The use of intrenchments will also greatly strengthen part of a line that otherwise might be dangerously weak. Even should the flank be found so skilfully posted and protected that it cannot be easily turned, yet an opportunity of bringing a converging fire upon some decisive point will very likely be found there. Villages and woods projecting forward from the general line also form good objects for converging fire, and besides bring a cross fire upon the ground between them so that it would be impossible to pass between them without first capturing them. Straight lines of earth-works on the other hand are not favourable for attack, as it is difficult to silence the fire from them. The selection of the particular points to be chosen for attack, if several present themselves for choice, will depend upon the amount of influence their capture is likely to have upon the rest of the position. Closed earth-works of strong profile would not be easy to take by assault, but their garrisons may be shut in and forced to surrender if the line can be pierced elsewhere, but if skilfully used on commanding points to enfilade lines of trenches will no doubt add greatly to the strength of a position, as they will greatly interfere with the assailants establishing themselves in any part of the position they may have forced.

When the points against which the main attacks are to be directed have been chosen, the General will arrange his troops so that while providing for demonstrative attacks on the whole position to prevent the defender from moving troops from other parts of his line to strengthen the points seriously menaced, he may yet always have troops at hand to reinforce the attacks on the decisive points and take advantage of any success that may be gained. Therefore, unless he has an enormous superiority of force, the points chosen should not be so far apart as to prevent the reserves from being so placed as to be able to reach quickly any point where their aid may be required without impairing the unity of the action under the Commander-in-chief. In the second and third battles of Plevna the points of attack were so widely separated that no combined action could be obtained, each

commander had to fight for his own hand and the reserves were frittered away.

As soon as the points of attack have been selected the artillery should be brought up to prepare the way for the infantry advance. If the attacks are to be made on such points as villages, houses, and woods, it will probably be desirable to continue the preparatory artillery fire for some time, as it will be effective in battering down walls, setting houses on fire, and splintering trees, and otherwise rendering the localities bad to occupy; but in the case of earth-works it does not appear as if field artillery as at present constituted could produce much effect on the works themselves, but can only be of use in preventing the occupants from showing themselves above the parapet. In such a case a lengthened fire would only be throwing ammunition away, as the effect of driving the defenders from the parapets by shrapnel fire would be produced as well by the first rounds fired with correct aim as by a lengthened bombardment.

In any case as soon as the defenders' artillery fire is caused at all to slacken, infantry should be sent forward in open order, to creep gradually within reach of the position and add their fire to that of the artillery. The form of the advance will be a chain of skirmishers followed by supports which will probably also have to open out, but which should be kept jealously in hand. Further back again will be more infantry, following wave after wave, as the tide comes in on the shore, each wave surging forward into the fighting line when the forward movement of the latter is checked, and sweeping it on a little further. These lines will not advance as wholes but bit by bit as opportunity offers, the stationary portions continuing their fire to keep down that of the defenders and enable their comrades to get on a little further. The artillery will also have to advance before its fire is masked, so that no cessation shall occur in its fire and no breathing time be allowed for the defenders to come out of their shelters. At last the lines will get within reach of a rush at the point of attack, the assault will be delivered, when the assailants have in their favour numbers and moral force.

The superior officers must be keeping a strict watch on the course of the fight, never allowing it to flag for want of timely reinforcement, but still keeping all the troops they can in hand to resist counter-attacks, so likely at the moment of assault, to secure possession of any point won, and make use of it as a vantage point for further advance. The effect produced by the capture of any part of a position depends upon the skill shown in the choice of the points of attack. The position won by Schakovsky on the 30th of July was comparatively useless, as the Turks possessed other positions behind it, whereas the redoubts captured by Skobeleff on the 11th September would have enabled him if properly supported to strike into the very vitals of the Turkish position.

The details of formation and arrangement of the attacking infantry appear to be of secondary importance, as long as the correct principles are followed; probably three or four arrangements might be devised, all equally good, but it may be remarked that, in view of the

probable necessity of the supports and even the first reserves of the shooting line advancing in open order, and the desirability of keeping them well in hand, our small companies would probably have an advantage over the large German companies. The reserves might very probably advance with success in half battalions or double companies in line. The French in their manœuvres this year have been practising deployment from mass into line formations at great distances, 10,000 to 12,000 yards, from the position to be attacked, and the writer has been assured by an eyewitness that often from the position nothing whatever could be seen of the army advancing to the attack, so little conspicuous are such lines in a landscape.

The artillery must remember that their duty is to give at all times support to the infantry, and must centre all their efforts on keeping down the enemy's fire and keeping up their own till the moment the assault is delivered. To do this it may have to brave even the enemy's musketry fire, as did the German batteries at Woerth and on the Rotherberg in the battle of Spicheren.

The duty of the cavalry will be to sweep round the enemy's flanks, to discover any sign of movement, to disquiet his rear, and to cover any turning movement of their own troops.

On the offensive as well as on the defensive, considerable opportunities exist for the skilful use of intrenchments. By their employment on the ground occupied by the army before commencing the battle, it will often be rendered safe to weaken greatly some part of the line to reinforce the troops at the critical points as the danger from a counter-attack will be diminished. The batteries of the attack will also find it most desirable to throw up some cover for themselves or they will find themselves getting the worst of the artillery duel.

General Frossard, speaking of the battle of Gravelotte, says of the Germans:—

"We could not help remarking their care in choosing suitable positions for their "artillery, in keeping it out of sight, in forming rapidly artificial means of pro- "tection for their batteries, and lastly in provoking the adversary's batteries by an "apparently timid trial shot, so as to get them to show their presence and im- "portance, that they might be able to oppose to them a very superior number of "pieces; all things, by the way, that our artillery also knows how to do, but perhaps "does not sufficiently practise."[1]

It is also of the utmost importance that troops should have the means of intrenching themselves in any step they may take in advance or any position they may win, as is shown by the example of Skobeleff's troops in the third battle of Plevna, and therefore that some system should be adopted by which troops should always have a sufficient supply of intrenching tools at their immediate command. What may be done in this way may also be seen in the case of the Pioneer Company working under fire at Champigny, in the sortie from Paris, 1st Dec., 1870.

Defensive Operations.

The farther an army enters into an enemy's country the more it is

[1] Frossard, "Rapport sur les Operations du Deuxième Corps." 1870, p. 116.

weakened, from the necessity of leaving troops behind to guard the communications, to secure occupied territory, and to invest or mask fortresses. If, therefore, a defensive army that does not feel itself equal to coping with the invader in the open field, gradually falls back before him, harassing him by continual checks in strong positions, but avoiding pitched battles, it may hope eventually, through the reinforcements itself receives, and the continual drain upon the enemy, to be able to meet him upon fairly equal terms.

But there is a natural reluctance to give up territory, without striking a blow in its defence, therefore, a General charged with the defence of a country will usually desire, before giving up any large amount of territory, to fight a battle, if he can do so with a fair chance of a successful issue. He will, therefore, wish to be attacked in a position of his own choosing, in which he can, by the use of intrenchments, compensate for his inferiority.

But, as we have already seen, the invader will only attack the defender in his position if he considers it less dangerous and more profitable to do so than to manœuvre him out of it. If, therefore, the position presents the appearance of great strength, it will defeat its object, as the enemy will not attack it, unless circumstances such as have been alluded to in speaking of the offensive forbid the attempt to turn it. Therefore, the paradox may be true, that a position may be too strong. What is required, is just so much strength, natural or artificial, as shall turn the scale in favour of the defender, without deterring the enemy from attacking. For this reason, works which do not make much show, such as prepared hedges, shelter trenches, &c., are better than more elaborate works which can be distinguished at a distance. If the ground can be made to conceal the strength of the position, as in the case of a line of works some distance back from the crest line of a plateau along which the foremost fighting line runs, like the works about Villiers and Cœuilly, in the investment of Paris, the advantage will be great.

But it is probable that an invader will hesitate to attack a position which the defending army has occupied some time, and therefore had time carefully to arrange for defence, even if he cannot distinguish extensive works, and will try to manœuvre the defender out of this position, in the hopes of catching him in some other before he has had time to fortify it very strongly. In this case it is evident how desirable it must be for troops to be plentifully provided with intrenching tools, so as to be able to do the maximum of work in their new position in the minimum of time. The defence of a country would also be much facilitated, if, behind the army in the field, some works of good profile were thrown up in favourable situations, to act as points of *appui* for the more hasty works that might be erected by the army itself, if it had to take up any of these positions. In this way the invader would find his difficulties very much increased, for he would never be able to find his enemy in an open position, but must eventually attack him with works of considerable strength to support him.

If, however, a General feels that he cannot meet his enemy in the

field with any reasonable prospect of success, even with the aid of such intrenchments as he can throw up, he must, however reluctantly, fall back, even at the cost of sacrifice of territory, until his enemy's losses, and the reinforcements he may himself receive, render the balance more even; or else he must seek the shelter of an intrenched camp, if such exists within his reach. The question of intrenched camps will be dealt with presently.

But it may occur that the defending army, though numerically weak, is better and more mobile than that of the invader, or better generalled. In such a case the defender's mode of action will be very different. He will be able to make his own skill and the mobility of his army counterbalance his enemy's numerical superiority, and he will be able to avail himself of the power given by intrenchments to a small force of holding out for a time, by intrenching a small number of troops to cover the decisive points, while manœuvring with the rest of his army on his enemy's flanks and rear, harassing his march, cutting off detachments, endangering his communications, and at times inflicting severe loss by attacking the unwieldy masses of his foe under favourable circumstances. Lee's campaigns in Virginia are striking examples of what may be done by small mobile forces against cumbrous masses unable to manœuvre, and the Duke of Wellington's campaigns in the Peninsula show also what can be done by skill and fighting power against superior numbers, hampered by divided authority and inferior tactics.

Defence of a Position.

The details of the means to be employed for strengthening a position in which to receive the attack of an enemy have been so fully and ably treated by Captain Fraser, R.E., in his Prize Essay on the Defence of a Position, and still more recently by General Brialmont, in his new work, "La Fortification du Champ de Bataille," that it seems unnecessary to do more here than call attention to some of the most important general principles that may be deduced from the review we have made of recent campaigns.

If a General takes up a position in the hopes of being there attacked, in order that the strength given him by his defensive attitude and works may enable him to exhaust his enemy's strength, and then, by a timely counter-stroke, inflict decisive defeat upon him, he will naturally choose some position suited to the number of men he can dispose of, though even in such a case there will always be a temptation to the defender to stretch his lines unduly, in order to secure, as far as possible, his flanks, as was the case in the Confederate position on Missionary Ridge. The extent of the position should be confined within such limits that the passive defence may be carried out with a part only (from a half to three-fourths) of the whole force, leaving the rest available for the decisive counter-attack. It is desirable, however, to extend the position to the utmost extent possible consistent with the above condition, to render turning movements more difficult. A small force can safely occupy a greater space in proportion than a large one,

because the commander can overlook the whole field, and one reserve will suffice; whereas, in the case of large forces, the commander will not be able personally to superintend the whole field, and two or more large reserves must be formed, to be at the disposal of the officers to whom may be entrusted certain portions of the line of battle. [Note here an advantage possessed by the attack, in being able to select points for main efforts, such that a single reserve will suffice, whereas the defence must be prepared along the whole line.]

For a small force under 20,000 men, 6,000 to 10,000 men per mile of front might suffice, but in the case of large forces 15,000 to 20,000 men per mile would seem to be a fair average proportion of troops to ground, but of course strict rules cannot be followed, a General must do his best with the positions available even if they do not exactly suit his numbers.

Requisites for Defensive Position.—Next comes the important point how the position is to be made most advantageous.

Clear Field of Fire.—From what has been already said, it is evident that the most important point is a clear field of fire. Remember the fire-swept glacis in front of the French position at Gravelotte, the stress laid upon clearing the field of fire in the instructions for arranging the investing lines at Metz and Paris, and the loss sustained by the Russians in crossing the zone exposed to the Turkish infantry fire before Plevna. Therefore, above all things, secure a clear field of fire, and if at any point it cannot be fully obtained, remember it is a weak point and requires special care. It must be occupied by the best and most trustworthy troops, protected by obstacles, and supported by strong reserves.

Cover.—The next important point is cover for the fighting line and reserves. The great strength of the centre and left of the Gravelotte position lay in the effective cover it afforded, next to its open field of fire. The features of the ground covered the reserves and shelter trenches and quarries covered the fighting line. Notorious also is the example of Plevna, where the Turkish fighting lines occupied trenches and redoubts well provided with bomb-proof and other cover, and the configuration of the heights afforded central situations for the reserves quite protected from the Russian fire, and facilitating the rapid reinforcement of critical points.

Cover obtained from the natural features of the ground is the best, and next that afforded by earth-works. A very slight movement of the earth will afford some cover, but if time and circumstances permit, deeper trenches give a decided advantage, as the example of Plevna shows. Care must be taken, however, that they do not interfere with possible offensive movements. Either large intervals must be left in the lines, or such a profile must be adopted as not to interfere with the passage of troops over the works. General Brialmont gives a number of profiles for choice.

Walls and masonry generally are not so good for defence as earth-works, on account of their liability to splinter. But the danger from this is less than is sometimes supposed, as walls will keep off shrapnel and rifle bullets; buildings, however, that can be set on fire, or caused

to fall in under fire, are dangerous, and therefore villages should be defended by trenches outside them and not by placing troops in the houses themselves. The buildings may, however, be used as traverses to protect reserves; and churches, or other edifices of exceptional strength, can be used as keeps.

Trace of Works.—The question of the trace of the works and the employment of closed works is an important one. They must be arranged so as to sweep with their fire all the ground over which the enemy can advance, and if possible, be so placed as not, if captured, to afford cover to the enemy. The arrangement adopted by the Germans before Paris seems good, viz., the placing of their trenches a little in advance of the actual crest of the slope (see former fig.). If this cannot be done, the rear slope of the trench should be so cut away as to give no cover from the fire of troops placed further back. Behind the first line at all points where attack is especially to be expected, such as salients in the line, a second line should certainly be prepared, so placed, if possible, that it shall be necessary for the assailants after they have captured the first line to bring up artillery within infantry range of the second line to prepare the way for the attack on it. This condition will be fulfilled if the second line is within 1,000 yards of the crest of the height on which the first line is situated. In such a case the attack of the second line will be very difficult to troops already wearied with their exertions to capture the first line, and may very likely be delayed till night falls, during which the defenders will have time to reorganize their defence. The German experience in the Battles of Noisseville and the Lisaine shows that if critical positions are not captured until so late in the day as to preclude their being immediately utilized, their possession by the enemy may very possibly be rendered comparatively innocuous by attacking them betimes in turn and so at all events reducing the troops in them to the defensive. Then renewed attacks on the rest of the line may be again repulsed and in such a case exhaustion will probably force the assailant to give up his enterprise and retire again from the points he had won. Compare also the fate of Skobeleff's attack in the third Battle of Plevna.

As regards the use of closed works, recent experience seems to show that they may be of considerable use if placed so as to enfilade lines of trenches. It will be very difficult for the assailants to establish themselves securely in any trenches they may have captured as long as the works that enfilade them are still in the hands of the defenders. The closing of the gorges will prevent these works from being captured from the rear by the troops who may have got into the trenches, and direct attacks on them will be rendered very difficult by the fire of the trenches on either side. It appears to be a doubtful question whether it is advantageous to place guns in closed works of this kind, though it was often done in the Turkish war, but probably mitrailleurs might be very advantageously employed to enfilade the trenches, and could more easily be removed in case of necessity than guns.

Protection of Flanks.—The protection of the flanks is a most important point. Even if the assailant cannot manœuvre the

defender out of his position by a strategical turning movement, the frontal strength of a position will certainly cause him to try and turn a flank on the battle-field. A position can hardly be considered a really good one unless one flank at least is strong by nature. An open flank may be strengthened by works judiciously disposed, and the defence of it aided by placing troops in echelon behind it, so as to take in flank any attack. Troops detailed for the protection of a flank should be especially well provided with engineers and intrenching tools, in order to be able to intrench themselves during the action itself in any situation that they may be forced to assume under unforeseen circumstances. Girard says: "C'est désormais sous les yeux " de l'ennemi, pendant la crise même du combat, que les troupes " doivent élever ces retranchements qui semblent seuls pouvoir contre- " balancer la valeur morale de l'offensive. C'est en effet le seul moyen " d'empêcher l'ennemi de tourner les dispositions défensives, que de " les créer pendant la cours de l'action. Tout champ de bataille " préparé de longue main peut-être tournée par une armée dont " l'offensive même suppose une supériorité morale ou matérielle. Dans " la cours de la lutte, au contraire, les conditions changent: il faut " prendre le taureau par les cornes ou rompre le combat, c'est-à-dire " se préparer une défaite tout au moins morale."[1] But it must be remembered that works thrown up in haste under such circumstances cannot be sufficiently complete to afford entire security, and the best way of meeting flank attacks is without doubt to prepare for an attack on them in flank and rear during their progress.

Position of Artillery.—As we have seen that the preparation by and support of a powerful artillery is almost indispensable to the success of an attack if it has to be delivered over open ground, it is desirable that the batteries of the defence should be so arranged as to be able to direct the most powerful and concentrated fire possible on the ground which the nature of the terrain points out, as that on which the assailants' guns will most probably be deployed. It will generally be possible for the defence to recognize this ground either through the limitation of possible artillery positions on the attackers' side by obstacles, or on account of features in the defensive position, rendering it certain that the main attacks will be delivered on particular points.

Outpost Positions.—Outpost positions strengthened artificially are desirable to force the enemy to early deployment and give time for the main army to take up its position.

Disposition of Troops and Method of Defence.—As regards the disposition of troops in a position and method of conducting the defence, the fighting line will be formed of infantry occupying the features of ground or trenches forming the main line of defence, as close together as is consistent with the free use of their weapons with supports in rear under natural or artificial cover. It will be sufficient if the supports are half the strength of the fighting line. A second line will be required of troops in close formation prepared to take the offensive

[1] Girard, "Applications Tactiques de la Fortification." Paris, 1874, p. 15.

against any attacks that may seriously endanger the line, but it is desirable not to pass to the offensive prematurely, but first to utilise to the full the power of fire, which is now the real strength of the defence. Circumstances will decide whether this second line should be formed of a certain number of companies from each battalion in first line, or of one or more battalions from each brigade or division.

Further, there must of course be the reserves.

The first efforts of the defence will be to prevent the enemy obtaining a superiority of artillery fire. This will be done by judicious arrangement of the defensive batteries, as already mentioned, the careful measurement of ranges, and sometimes perhaps by infantry or cavalry attacks if the assailant has incautiously sent forward his batteries without a sufficient escort, as the Germans did sometimes in 1870. The infantry attacks must be met by the fire of the artillery and infantry of the defence fully utilised, and eventually if necessary by counter attacks by the second line or in case of serious danger by the reserves.

The question of fire at great ranges has been much discussed lately, but still apparently remains an open one. It may, however, be remarked that although the distant fire of the Turks caused considerable annoyance and loss to the Russians, yet it was at the cost of an enormous expenditure of cartridges which it may not always be desirable to incur. The Turks have an advantage in requiring a minimum of food and other stores, so that a greater part of their transport can be made available for ammunition than in the case of most European armies. And with a properly open field of fire the effect produced by the fire of the defenders at ranges within which aim can be effectively taken ought to be sufficient to repulse an attack as long at least as the assailants cannot escape from it either by cover or by silencing it with superior fire. In the American War assaults were stopped even when they had got to within 80 yards of intrenchments by the fire of muzzle-loaders, and *à fortiori* troops armed with breech-loaders ought to run no risk by allowing the enemy to advance to a distance from the position within which good aim and consequent economy of ammunition is possible. The artillery should be able to force the enemy into an early deployment from mass formation, though even with artillery it may be questioned whether the results obtained by very long range fire will generally compensate for the expenditure of ammunition.

So far we have been considering the means by which the utmost strength can be given to a position, but a General must remember that, as has been already explained, his enemy will not attack him except of necessity, if he has no prospect of obtaining a successful result, and therefore if it is possible for the enemy to avoid the position it should not exhibit too great strength, but conceal it as much as possible, so as to tempt assault.

Covering Positions.—It may be that a position is taken up not with the desire of fighting a battle, but for the purpose of covering some important point or operation. In this case the General will strengthen his position to the utmost, as his point will be gained if he

deter the enemy from attacking, but he will very likely have to spread his army over an unduly large space to prevent the enemy from outflanking and passing by him, as occurred to Von Werder before Belfort. In such a case the utmost vigilance must be exercised to obtain the earliest information of the direction of the enemy's advance. Reserves are required even more than in the ordinary case of a defensive battle, to be kept in hand to reinforce the most dangerously threatened points, and good communications between parts of the position are most important.

In all defensive operations the cavalry should display the utmost activity and daring in endeavouring to detect the movements and intentions of the enemy.

Intrenched Camps.

Intrenched Camps.—There is one more point to be considered, viz.: the value and use of intrenched camps and the correct method of operating with regard to them of the army acting on the offensive.

An intrenched camp on the flank of an invader's line of march, occupied by a field army, must be a subject of serious consideration to him. It cannot possibly be disregarded, or the army it contains will be able to destroy the invader's communications and do incalculable damage. But if the General of the invading army decides on investing the camp he thereby locks up a considerable part of his force for a longer or shorter time. Metz delayed the 2nd Prussian army from the 19th of August to the 27th of October, and Plevna kept the Russians before it for nearly 5 months. And what was the result in each case? The Germans found themselves strained to the utmost to carry on simultaneously the investments of Paris and Metz and make head against the new levies being raised in the South of France. They had everything prepared to raise the siege of Paris when Metz fell, thus releasing the 2nd army and relieving the strain on their resources. What might have been the result if Bazaine, instead of sending away provisions and stores from Metz, had collected all he could from the country round and voluntarily remained with a considerable part of his army in the fortress? His force, unbroken by previous severe defeat, would have required as many German troops to have invested them as were required under the actual circumstances, and the rest of his army could have joined MacMahon, who would not have made his fatal attempt at relief, but could have thrown part of his army into Paris to secure the capital and retired south with the rest to form the nucleus of new armies. If the Germans under the actual circumstances could hardly carry out their plans, they certainly could not have done so under the supposed conditions; the siege either of Metz or Paris must have been raised, and the tide of success once arrested, who can say what might have been the eventual result? It would not have been the same thing if Bazaine had succeeded with his whole force in joining MacMahon. Even united, they were not a match for the German armies in the field, but would have had to have fallen back on Paris or elsewhere. But no more troops would have been required to invest

Paris than were actually employed, or at all events not many more, and the Germans would have had plenty available to check the raising of fresh armies in other parts.

It must be admitted that an army once invested in an intrenched camp must eventually be lost unless relieved by external events, for investing lines having no flanks can be made practically impervious to sorties. Therefore the calculation must be made whether the time gained by the delay of the enemy before the intrenched camp can be so employed that the tide of invasion may be turned and the invested army relieved before it is forced to capitulate, or at least some result may be obtained that shall more than compensate for the loss of the army. We have seen how Metz might have given an opportunity to France; and how Plevna gave Suleiman Pasha time to bring up his army; and if instead of shattering it against the barrier at Shipka, he had carried it over one of the lateral passes either to join Mehemet Ali or against the Russian army before Plevna, it is difficult to see how the Russians, reduced to great straits as they were, could have avoided some serious disaster, which might have led to their recrossing the Danube.

Therefore on the defensive it would appear that intrenched camps may do good service when the army is not fit to encounter the enemy in the field if the gain of time will bring any alleviation of the situation, and if the capital or vital point is safe from a *coup-de-main*, and can delay the invader before it.

We will next look at the question of intrenched camps from the invader's point of view. In the first place, if the defenders have occupied some position which they have had time adequately to fortify and turn into an intrenched camp, it would be wrong to assault it unless the defenders are known to be very inferior in *morale*. What course then ought to be pursued? We have seen that to invest the place is very often to play the defenders' game. The thing most to be desired is that the defenders should come out of their works and give the invaders a chance of defeating them in the open. Therefore the best course, if the invading army has a strength anything like adequate to the task it has undertaken, would be to leave a force in a suitable position to protect the communications, to leave open the line of retreat of the enemy and to push forward the bulk of the army towards its main object. Then the chances are ten to one that the force in the intrenched camp will be recalled in haste to defend the threatened point and a chance will be offered of defeating it in the open field. The force left to guard the communications will usually not need to be nearly so strong as would be necessary for the investment of the camp.

We can scarcely think it was judicious of the Germans to shut Bazaine up in Metz. They could hardly have anticipated such a false move on the part of the French as the sacrifice of MacMahon's army in the effort to relieve him, and in default of that we have seen how dangerous their position would have been. With the confidence they had in their own fighting power, it would have been better, after they had succeeded in checking the French march on the 16th August to have allowed Bazaine to make another attempt to get away, using the

third army to keep MacMahon at a distance. Bazaine might then have been attacked on his march and perhaps driven over the Belgian frontier, while the third army was enough to give a good account of MacMahon. Even if a considerable part of both French armies had reached Paris it would have been better for the Germans than shutting Bazaine up in Metz, for they would have had only one investment to carry on, as has been already explained.

The case of Plevna shows up yet more unfavourably. By General Todleben's own account[1] the army of investment in November numbered about 120,000. There must evidently be something wrong if 120,000 men can be neutralised by 50,000 or 60,000, which was all Osman Pasha had in Plevna. The Russians, who knew by old experience that the principal strength of the Turks lay in their obstinate defence of intrenchments, and that they did not shine in fighting in the open field, should have recognised that Osman Pasha was not much to be feared if he attempted the offensive, and therefore should have left a moderate force between the Lom and the Osma to guard the communications and the bridges across the Danube, and have pushed across the Balkans with their main body. Osman and Mehemet Ali would certainly have been hastily recalled to protect Adrianople and the capital, and might have been caught in their march and defeated before they could join Suleiman, as the Russians were on the shortest road across the Balkans to Adrianople.

Therefore we see on the whole that an intrenched camp may do good service to the defender if the invader invests it, but that it will generally be to the advantage of the latter not to do so, but to endeavour to get his enemy to leave his works and give a chance of fighting him in the open. Hence it will not be judicious for the defenders to form strategical intrenched camps except in situations, the retreat from which it will be very difficult for the enemy to intercept without completely investing them.

Conclusion.

The general conclusion which seems to offer itself to us from our examination of the modern conditions of war, ought not to be displeasing to us as Englishmen if we still retain old traditions and qualities. It is that intrenchments give an advantage to small and mobile armies composed of good fighting material as opposed to larger forces with less manœuvring power and of inferior quality. This advantage is gained by the power given by intrenchments to a small resolute force of holding its ground for a time against superior numbers, in virtue of which power vital points may be safely left in charge of small numbers of troops while the bulk of the army is using its superior mobility and fighting power to puzzle, outwit, and defeat the more cumbrous masses of the enemy. A General in command of an army he knows to be of superior quality to that of his enemy should

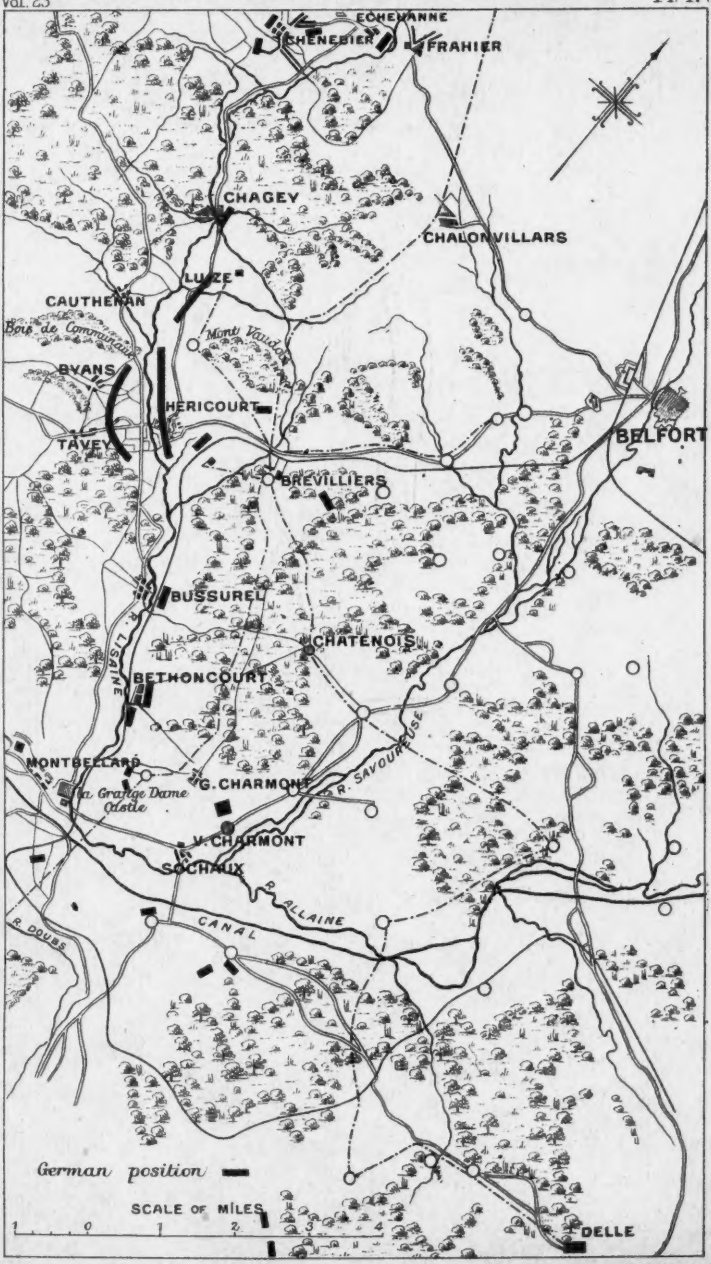
[1] Letter to General Brialmont, "Revue Militaire de l'Etranger," No. 400, April 27th, 1878.

remember that now as much as ever his motto should be "L'audace, l'audace, l'audace!"

But it is to be feared that we cannot trust to intrenchments to atone for inferiority of quality or of numbers, if the quality of the two armies is equal, unless under the conduct of a General of exceptional ability, or under local circumstances which will not be of frequent occurrence. Such local circumstances might indeed be found if England should ever be invaded and time has been afforded to throw up strong works in suitable localities, so that in whatever direction the invader may advance he may be met on a battle-field provided with the strong support afforded by such works. Even in such a case it will not do to be too confident, for we cannot be certain that good troops will not be successful against even a very strong position if held by troops lacking confidence in themselves and with whom the General would find it difficult to meet unforeseen emergencies.

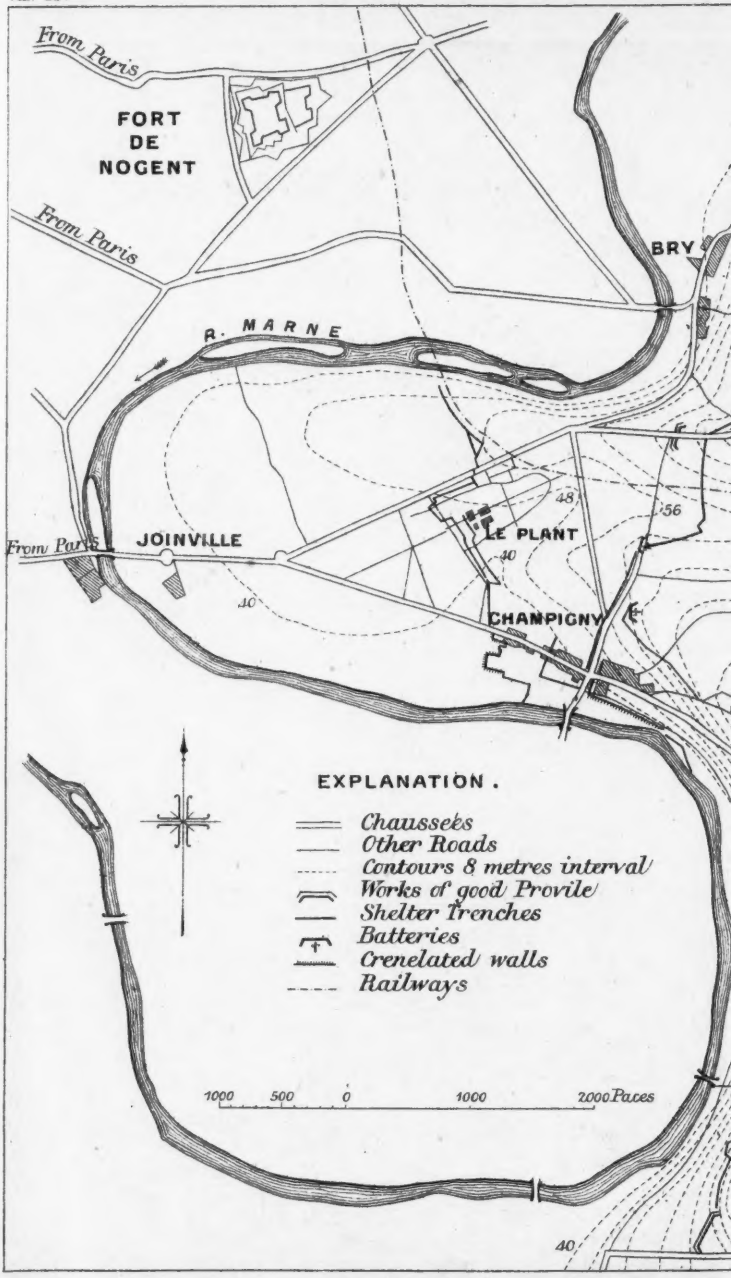
But, may God grant we may never have to undergo such experience in these islands.

BATTLES OF THE LISAINE.



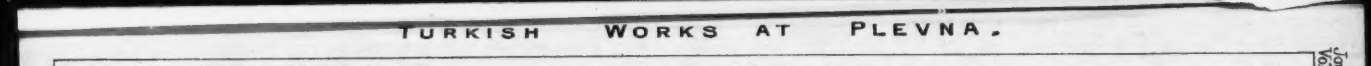
Thos Kell, Lithographer.

GERMAN WORKS BEFORE



Thos Kell, Lithographer
40, King St Covent Garden

TURKISH WORKS AT PLEVNA.



TURKISH WORKS AT PLEVNA.

Fig: 1.

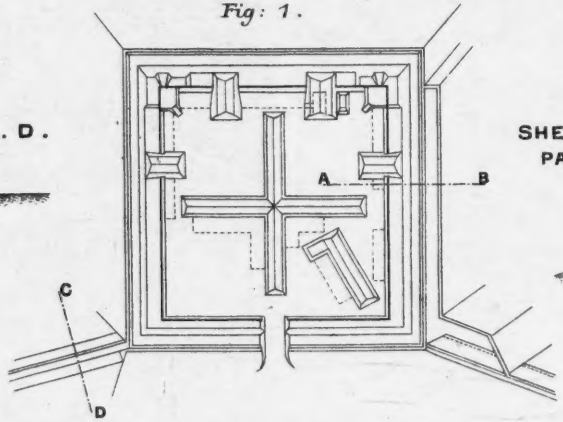


Fig: 3.

PROFILE OF TRENCH C. D.

Fig: 4.

SHELTER FOR RESERVES 100 PACES BEHIND REDOUBT.

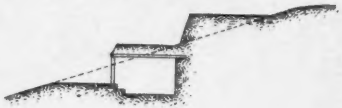
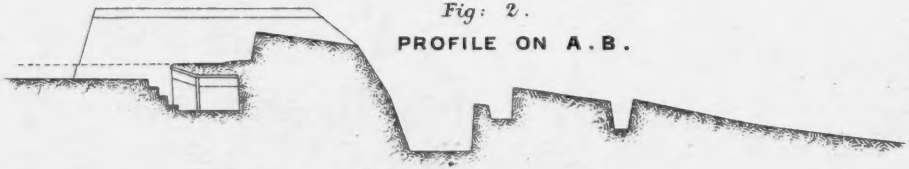


Fig: 2.

PROFILE ON A. B.



SCALE FOR PLAN.

10 5 0 10 20 30 40 50 60 70 80 90 100 *Yards*

SCALE FOR PROFILES.

10 5 0 10 20 30 40 *Feet*

LOOKING TOWARD MOORE'S TAVERN

GOLD MEDAL ESSAY.

[*Extract from the award of the Referees.*—"We consider the place of honour in the competition won by the writer of an Essay bearing the number 477, and the motto, 'Non sine pulvere,' but we regret that the terms of the competition deter us from awarding it the Gold Medal, as it considerably exceeds (to the best of our calculation) the prescribed limit of length."] In these special circumstances the Council awarded a second Gold Medal to Major Fraser, R.E. It should be mentioned that the length of the Essay was carefully computed by the Printers, and found to be 64 pages; some reductions in it have since been made.—ED.

FIELD INTRENCHING: ITS APPLICATION ON THE BATTLE-FIELD AND ITS BEARING ON TACTICS.

By BREVET MAJOR T. FRASER, R.E.

No. 477.

"Non sine pulvere."

"Il faut changer de tactique tous les dix ans."—NAPOLEON.

ANYONE who has watched the history of war must have been struck with the fact that the balance of advantage has generally rested on the side of progress. Changes in tactics are due to several causes, sometimes to political conditions; those for instance which rouse the enthusiasm of untrained masses, as in the American war of independence and the French revolution, where nations bent on success, yet unused to fight, gave birth by instinct, to the *dispersed order* of fighting. More often change is due to *Leaders* like Napoleon, who, by the gift of genius, discover new uses for the instruments they find in their hands, and force the enemy to face the unforeseen.

Of all causes, however, change in *Arms* and the progress of inventions have, by altering the balance of importance of the different weapons, most deeply modified the tactics of their day. Before the introduction of firearms, and with the exception of the slight influence of hand missiles, fighting was entirely a question of shock; and, unlike the present day, the use of field *Fortification* was then not so much to protect from missiles as to *ward off shock* or to give the defender a *vantage*. For the want of penetration of hand-missiles permitted the use of armour, and rather favoured shock tactics: while, since firearms have replaced almost all others, and particularly lately, *protection* from their effects has become the main object of field fortification.

Again, each marked improvement in arms has called for a corresponding change in tactics. In the middle ages, the feudal system made *Cavalry* dominant, till in our French wars the national aptitude for active defence was shown by our developing an infantry of archers

accompanied by dismounted knights, and fortified by palisades against the shock of ironclad cavalry. With a similar object the Hussites made *Waggon Parapets* of transport waggons, to break the charges of horse; and this method lasted till artillery progressed enough to overcome its resistance, and still obtains where guns are not used.

In the XVth century *Musketry* began to make itself felt, especially in its action on cavalry, which, in the XVIth was enabled by improvements in firearms to employ them itself with greater effect; till, with their further development, it again gave way to infantry; and then armour, which had been constantly increasing in weight, failed to be longer proof, and fell into disuse. At this time too the progress of musketry outstripped that of artillery, which fell into the background; only one gun per 1,000 men being the proportion used.

Next we find great progress made in fire fighting under Gustavus Adolphus, who brought in the musket cartridge, increased the proportion and mobility of *Artillery*, adopted a line formation to favour his superiority of fire; and so drove his enemy to use field-works.

The increased rapidity of fire, due to the introduction of the flint lock, and the invention of the bayonet, once for all rendered the musket the only arm for infantry, and again gave a preponderance to that arm, which led in part, under Marshal Saxe, to considerable use of prepared defensive positions.[1]

Under Frederick the Great, *Fire Tactics* progressed and musketry made way.[2] To meet the tactical use of ground for defence, and the employment of intrenchments by his opponents, the curved fire of howitzers was for the first time systematically employed, and horse artillery was introduced with a view to *mass firing* on the decisive points. This concentration of artillery brought about results till then unknown, and as mobility further increased, the method culminated in the hands of Napoleon;[3] while the development of small arm fire with the smooth-bore, combined with the active defence, reached its limit under Wellington. These changes, however, were progressive rather than revolutionary; those brought about by the *Rifled Arms*, which came into use in the middle of this century, were much more marked, especially in the war of 1862–64; while the recent introduction of the breech-loading small arm has produced a new era in fire tactics, inasmuch as it not only increased the possible rapidity of aimed fire *four* or *five fold*, while that of artillery has remained stationary, but also gave, for the first time, to attacking infantry, the power of *fighting continuously while in motion;* and to that of the defence, an enormous increase of defensive power. To the breech-loading small arm especially, and in a less degree to rifled artillery, are due the changes which have been forced upon the armies of to-day, and among others the larger use of field intrenching by both the defensive and offensive.

[1] At Fontenoy a closed redoubt behind the wood of Barry defeated all the English efforts, and was successfully used by him as a base for his counter attacks.

[2] The iron ramrod was only one of several of his improvements (Mollwitz).

[3] The invention of shrapnel boldly adopted by us *during* the Peninsular War, gave to artillery fire perhaps the greatest relative superiority it has ever had.

Before proceeding further to consider how the new conditions have given a new importance to fortification, and how this latter has reacted on tactics, it will clear the ground to see how the *Relative Efficiency of the Present Arms* now stands, as compared with the end of the smooth-bore period.[1] If, instead of looking at the question as one of relative ranges, we consider (Pl. VII) the relative areas affected, the results give, it is thought, some idea of the extraordinary increase that has now taken place in the arena of the fight, and in the importance of the small arm. In the first place it appears that the *Area* covered by effective musketry fire, is now at least *sixteen* fold that with the smooth-bore, and that the area now covered by effective shrapnel is about *four times* as great as that with smooth-bore shrapnel, which, up to its effective limits, was not much inferior to that of to-day (Fig. 4, Pl. VIII). That while in the smooth-bore period, effective shrapnel covered an area at least thirty-six times that covered by the musket, the areas now covered by effective shrapnel and musketry are only as nine to one, nor is it to be forgotten that the effective range of smooth-bore canister was twice or thrice that of musketry; a state of things now more than reversed; and lastly, if we take the extreme areas commanded by the present arms, the ratio becomes only four to one. These facts make it plain, that as regards command of ground, the comparative gain of musketry is enormous, added to which the *quantity* of its fire is augmented in the same relative proportion; while, with each increase of range, that invariable factor, the limit of *distinct* vision, tells relatively more and more against the longer ranging arm. Again, as to the manner in which each arm performs the function of distributing bullets; at first sight the gun appears to have a great advantage, for while "aiming" is in each case affected by personal error, with the gun, owing to its steadiness, it is much less so influenced, and can be more readily corrected by observation of the effects. The method of *Musketry Mass Firing* however (developed since 1870–71, and but imperfectly applied in 1877) promises to supersede, in a measure, the wild unaimed fire at long ranges which has up to this time prevailed.[2] In this way results are obtained on a system of averages, instead of being dependent on individual accuracy (Pl. IX). Hence, for the future, artillery will no longer have a monopoly of aimed fire at the longer ranges.

Then, by firing a mass of bullets in a volley, the "strike" can

[1] There will of course be much difference of opinion as to the assumptions therein made. They have, however, with the rifled arms, been based rather on personal observation of their effects in action than on theory. Todleben also says the Turkish infantry fire told up to 2,200 yards, and others mention losses at even longer ranges. S.B. Shrapnel is now a matter of tradition, but in 1813 its inventor found that carbine bullets freed near a 2-inch screen of fir, penetrated it when a mile from the gun; it is thought therefore its effects have not been overstated, those of the S.B. musket are certainly not understated. Rifled case has to be reduced in weight to give it the muzzle velocity of S.B. case.

[2] It is surely desirable that our arm, essentially a long range arm, be sighted beyond 1,400 yards, while the Gras is sighted to 1,960. In 1877 the Russian soldiers were driven to improvise wooden sights for their Kranke rifles; and already there are complaints that the Berdan is not sighted high enough (Table IV).

often be observed,[1] and the power of correcting its aim is thus conferred on infantry as well as on artillery, while individual errors are merged in the general result, and tell more at the *short* than at the *long* ranges. At the latter, an error of a degree in aiming may not cause the range to vary 100 yards; while at the former, it may make the difference of a quarter of a mile. Further, while the efficiency of musketry depends on fairly correct aiming alone, shrapnel has a second element of uncertainty about it, namely, the necessity for correctly bursting the shell: for while the distribution of hits with mass firing is tolerably uniform, over and under the given range, and, with several sights, is nowhere very dense, from the nature of the case, shrapnel bullets are much more densely distributed than efficiency requires in the nearer and narrower portions of the area affected, and much more widely scattered at a distance from the burst; the musketry hits being distributed like a belt of stars, those of shrapnel over an area of comet shape. (Fig. 14.) Hence the necessity, with shrapnel, both for true shooting and for correct bursting; conditions which fail to be fulfilled in war, considerably below the extreme range of the shell.[2]

An able writer in the *Nineteenth Century*, himself an artilleryman, who, as a spectator, has had great opportunities of forming an opinion, admits, by the remedy he suggests, the hopelessness, under the present conditions, of fighting guns under musketry fire. With both arms, and apart from the diminution of accuracy, the sweeping[3] effect in the open decreases very rapidly with greater range and drop: a fact that the extreme advocates of long range fire are apt to overlook. With musketry, the trajectory is so flat, at all events up to what has been assumed to be its most effective limit, 800 yards (Fig. 13), that most bullets falling short, ricochet at a low angle, and with effect, except against cover; at similar ranges the sweeping effects of shrapnel within the narrow limits of the cone would be great

[1] This, however, is contingent on weather. In very wet weather, or wet soil, or ground covered with growth of any kind, observation is difficult; hence the urgent necessity for providing battalions with ready and portable range finders.

Without attaching undue importance to peace practice, it may here be worth while to draw attention to the systems now being developed on the Continent. In Germany and Austria the method of using *Several Sights* in one volley has been employed for some years, with what results may be judged from the attached tables (I to III). The French, not satisfied with this, have this year made extensive trials at Chalons, their principle being to select such *Intermediate Marks* (Fig. 16, Pl. X) that, when fired at with certain sights, the distant object is reached. The results are said to be most satisfactory up to 2,000 yards, with whole battalions, and the recruits can, it is found, aim much more easily at the nearer objects. The system, however, seems more suitable to sieges and deliberate attacks, where there is time for calculation and observation, than to ordinary field operations. The "Voiennyi "Sbornik" mentions that a rough application of it was used near the Shipka Pass by a Russian detachment, which by firing at the tops of some trees, drove a Turkish force back from the border of a wood, distant 800 or 900 yards; the Russian rifles being only sighted up to 500 yards.

[2] The Russians, in the war of 1877–78, burst shrapnel in the air at ranges at least as great as 4,000 metres; the material effect was *nil*, the sound was very curious.

[3] When balls or bullets ricochet, they lose so much pace that the rising part of their flight is alone of much value, and as the drop increases, the catch becomes shorter and shorter. (Pls. VIII and IX.)

in proportion,[1] but in the nature of things, the breech-loader denies short ranges to artillery,[2] particularly that of the attack; for while the defender's guns can wait for close quarters, it is just the act of advancing that exposes the others. It is true that at Gravelotte, a German horse-battery existed for a time at 900 yards from the French infantry, but this was exceptional, and the balance of opinion after the war of 1870–71 was that within 1,000 yards guns could hardly be exposed to musketry. Since then, the improvements in, and more scientific use of the small-arm will, it is thought, further increase that distance under ordinary circumstances perhaps to 1,400 or 1,500 yards. Thus in the German musketry regulations, it was, before 1877, laid down that batteries might be fired at up to a distance of 550 yards. In those of 1877, we find this extended to 1,340 yards, while as early as 1875 the Austrians had extended their field firing from 500 to 1,200 yards. Hence as regards grazing effect, gun fire will, as a rule, begin with a drop not much less than that at which the most effective musketry fire leaves off. (Fig. 7.) On the other hand searching effect increases with drop, but of necessity at the expense of sweep and accuracy.

One more point about fire deserves mention, because, during the late war especially, it forced itself on our notice. It is, that it makes a very great difference whether the mean *time of Flight* of projectiles be less or greater than the rate of sound. This is more especially the case with artillery fire, though when exposed to volley firing from unseen infantry, it may sometimes be a consideration. From Table IV it can be seen that, with musketry, the rate of flight and of sound is practically the same, at all events up to 800 yards; while at 2,000 the time of flight is nearly double that of sound. In 1877–78 the Russian shells were wanting in velocity; in firing at earthworks or working parties this told very much, so much so, that Todleben admits his salvoes of 60 shells to a redoubt soon lost their charm, and failed even in moral effect. With our present field artillery, the shell beats the sound only up to 1,500 or 1,600 yards. At 2,400 yards, sound is a second, and at 4,000 about four seconds in advance.[3]

[1] Major S. Nicholson. R.H.A., in a valuable paper on shrapnel, points out from experiments that its efficiency at 800 is more than thrice that at 2,000 yards.

[2] Though peace practice is apt to mislead, and must be greatly discounted, it may be remembered that in 1874 a native infantry regiment, with the Snider, made nearly 2 per cent. of hits on the *personnel* of a battery in the open at an unknown range of 1,200 yards, while this year with the Martini-Henry, Europeans at 1,500 yards, made, with volley firing (which proved much more effective than individual firing) nearly 20 per cent. of hits on partly covered gunners. (Indian Musketry Experiments, 1878.) The results of trials with shrapnel fire are more variable. In 1875, in India, between 1,400 and 700 yards, three hits were made for every four shells fired at infantry dummies: at Okehampton the results were far better, but, as shown by war, the infantry results are the more reliable; for while in actual fighting the gun and its detachment are stationary, and often exposed, the infantry fired at are either in motion or under cover. The perturbations of action on aiming are about evenly divided. If anything "nerves" tell less on infantry, who have no fuzes to time, and whose individual errors affect results less.

[3] Theoretically sound has a speed of about 1,130 feet, more or less. In the newest gun (the French) the shell is in advance of sound up to 2,200 yards.

There are, however, elements *of Permanent value* about artillery which *must* not be lost sight of.

The first is its *Moral effect*, particularly on the rank and file, especially when armies come, as they do now, into the field made up chiefly of young conscripts.[1]

The second is the greater power conferred by its range of *Converging* on the proposed point of assault, and there overcoming the defender's resistance. In this power, however, musketry soon promises to claim a share; still we must not be misled, by the results of one war, into ignoring the value of artillery, which, though not the decisive arm, is the one which the General can longest call his own, and can direct to his purpose, even when it is in action, which is no longer the case with infantry when once engaged.

A third is its capability of being directed at *Night* on selected areas and along given lines; a power that is wanting with musketry.[2]

We have entered thus at some length into the changes which, as we have seen, both in France and Turkey, have so greatly modified the use of arms, and consequently the whole framework of tactics. With the exception of what can be gathered from the irregular operations of the late Carlist war, the lessons of 1870–71 and of 1877–78 can alone be taken as bearing directly on the near future. Fortunately for this purpose, most of the conditions are as widely different as is well possible, and therefore represent between them the largest number of future contingencies. There is, however, one point of similarity, the invader in each case had a very inferior small-arm; on the other hand, the German artillery was superior in all points to the French; while the shooting qualities of the Russian guns were inferior to those of the Turks:[3] nor is it possible to conceive a wider difference than existed between the two *Theatres*.

[1] A French Officer who served on the General Staff in 1870, lately told the writer he noticed the moral effect of artillery fire was confined to the men, who seemed less impressed with musketry fire than the Officers; being happily *more ignorant of the theory of probabilities*.

[2] At first sight this appears to be of less moment, but the development of night attacks promises to be so important that, looking to the disadvantages of mitrailleurs, it is a question whether some form of portable rest (Fig. 15) (weighted if necessary with earth or sand bags) might not be devised, at least for the defence, to hold from six to twelve rifles which could be given any required elevation. These infantry batteries would permit the use of fire at night; and in the day might be employed for long range or indirect fire against special objects, or in the absence of artillery, in a measure to replace it. In many cases, too, the system might be employed for range finding. A pack horse could carry a couple, and there would not be any question of ammunition, as the nearest squad could supply it.

[3] The bulk of the Russian infantry was armed with an inferior converted rifle (the Kranke). The Guard corps and cavalry had the Berdan (Table V). The Kranke had a muzzle velocity of only 1,100 feet. In Armenia the infantry arm was also a converted one, like the French Tabatière. The Russian field artillery were 4-pounders (shells 11 lbs., gun 5½ cwt.) and 9-pounders (shells 22 lbs., gun about 11 cwt) The muzzle velocity of these is only about 1,000 feet. They are, therefore, ill fitted for shrapnel, though their fuzes appeared to act very fairly. The use of shrapnel seemed to be well understood; it was chiefly employed against infantry. The Turks had been persuaded by Krupp of the virtues of a new com-

In France the land is much less enclosed than in England, but, as with us, centuries of civilization have perfected all the means of communication; under such circumstances, the invader, who, besides his other advantages, was possessed of a manœuvring power never surpassed, had everything in his favour for making the rapid and decisive strokes which, in the early part of the war, generally denied the French the time for defensive *preparations*. In Turkey, with the exception of two bits of railway, of which good strategical use was made, the *Communications* in Europe and Asia are at least as bad as are to be found in any part of the uncivilized world; hence the difficulties of supply were excessive; and movements, with the exception of those of cavalry, were extremely slow. Ample opportunity was given for the preparation and defence of positions, and the employment of artillery was much restricted; for, on both sides, the pieces and carriages, designed for the roads of civilization, were ill suited for the difficulties to be overcome.[1]

In France, the Germans, with a superior artillery, fresh from the much needed lessons of a previous war; conscious of the shortcomings of the needle gun, and unhampered in the movements of their guns; gave a prominence to their action which will in future seldom be favoured by such a variety of circumstances. The only element that was absent was the use of *Shrapnel*. On this subject it was predicted, not without show of reason, that, when well timed shrapnel came into play, the effects of artillery would be still more striking. The prediction has been tested in the war just over; as to the results—spectators and combatants appear to be alike agreed; though apart from local circumstances, we must admit there was a want of boldness and initiative in the handling of guns in 1877 that often led to their employment at ranges at which common, or even shrapnel, shells are as harmless as pumpkins.[2]

mon shell of his, as a substitute for shrapnel, of which, in consequence, they only carried 12 per cent. and therefore were always afraid to use it. Hence their fire was chiefly with common shell, and their powder gave but low velocities little superior to the Russian. Thus in firing at 4,500 yards, they often used 25° of elevation.

The objection to the present form of mitrailleur (the Gatling) is that the system requires to be of considerable weight for the steady working of the handle. Up to this time the arm has been looked upon as a bullet-shooting machine for direct fire; it is a question whether, as a rule, it is worth its weight for this purpose; but it seems likely to have a new field for usefulness as a means of aimed musketry fire against works. Within the last few months, experiments in Russia have shown the possibility, with the Gatling, of getting 23 per cent. of hits on targets, behind a 7 foot parapet at 1,660 yards. If a *simpler* and much lighter machine can be got to do this, even if it only fire volleys, and be not self-feeding, it would, on the whole, be better. For caponiers and confined spaces, the absence of recoil in the present type is of course a great advantage. Everything of the kind, however, is out of the question unless it shoots the small-arm ammunition. The Russians used Gatlings before Kadikeue with no results: the Turks employed them, but without very marked success, at Plevna.

[1] The usual araba track is 3 ft. 10 in.: some less.

[2] There were, however, some brilliant exceptions in the use of artillery. At Taghier (Pl. XV) the Russian guns were well massed, and were employed at about 1,500 yards range, the Turkish infantry fire being utterly wild. In resisting the Turkish left attack at Chairkeue (Pl. XIII) a few advanced guns (unopposed, however, by

While in 1870–71 the utmost use was made of the encircling and converging power of massed artillery, in 1877 a want of belief in its use (among both the Turkish and Russian leaders), hindered its development and led to a feeble sprinkling about of guns, and to counter-battering rather than enfilading. In Turkey the nature of the country, cut up as it generally is by deep ravines, often left no choice of artillery positions. Thus at Chairkeue the only available sites for the Turkish guns were far too distant to give proper support to their advance. At Zevin (Pl. XIV) it is hard to see where, the frontal attack having been decided on, the much-abused Russian gunners could have done better. At Plevna, too, the ground regulated the range.

Again, in France, when the war entered into the phase of investments, the invader at Metz, at Paris, and on the Lisaine could attain his object while remaining on the defensive, and in doing so made extraordinary use of field fortification: and here again local circumstances played an important part. The houses and villages in France are chiefly built of stone, often in a substantial manner, particularly near the cities, where also masonry enclosures abounded; consequently a very great use was made of these for defensive purposes; the villages supplying, with but little preparation, convenient decisive points. As a rule the shooting lines were placed in advance; but the important part played by village fighting in the war, gave a more favourable idea of the use of artillery for the attack than if the defences had all been of earth: thus in the battles before Metz, Coigny and Flanville were fired and rendered untenable by artillery alone.

Again, the great extent and age of the *Woods* in many parts of France, coupled with the knowledge of woodcraft possessed by many of the invader's troops,[1] gave scope for much wood fighting and for the use of timber in defence.

In Turkey, on the other hand, though the use of field works is traditional, artificial localities are very rare. For the sake of water and shelter, most of the villages lie very low in the valleys, and except the Mosque or church and "Konak" the bulk of the houses are of mud on wattle or wooden frames; and further, with the exception of the wattled garden fences, there are no enclosures in the country; consequently habitations and enclosures played no part in this war: redoubts formed the decisive points and earth entrenchments were everywhere used. Indeed, so universal was the employment of field works

artillery) engaged the Turkish skirmishers with ease, till actually reached. Again in Skobelow's attack on the Green Hills (Pl. XI), the 5th battery of the first brigade advanced against a Turkish sortie, but getting rather close, it lost nearly all its men and horses, and was simply paralysed. The Turks, be it remembered, were here advancing in the face of the fire of some 40 guns; most of them under cover. At Lofteha (Pl. XII), after the Red Hill, east of the town, had been captured, some guns at once followed the infantry on to it, and supported their further advance. Against the Aulia-Tepe (Aladja-Dagh) 67 Russian guns, at 1,800 yards, in 3 hours, caused heavy loss in the shelter trenches At Nicopolis 48 guns gave good support to the attack. (*See* Hozier's "Russo-Turkish War of 1877–78," p. 458, for plan of Bulgaria, and pp. 831 and 851 for Armenia.)

[1] The number of cutting tools (96 hatchets per battalion) also favoured this.

that hardly an action was fought in which they did not play some part. Of timber there is a good deal, but the bulk of it is low oak scrub. The Turks were very apt at clearing this away, but neither they nor the Russians seemed to have much idea of using timber for obstacles. In Lazistan, for instance, north of Batoum, where a covering position was carefully fortified, great labour was spent by some Turkish battalions from Servia, in preparing a number of redoubts of small profile, while the splendid beech timber on the spot, which would have formed admirable abatis, was made no use of.

In the war of 1877–78, *Earth Works* were especially favoured by the nature of the soil; on the surface generally light and easily worked,[1] and a little deeper, stiff enough to stand for a long time nearly vertically; consequently hasty cover was readily made: in the deliberate preparation, cover from searching fire was easy to provide and, in some cases, the ditches could be made steep enough to be of use as obstacles. Besides this, wattle-work being, so to speak, the national building material, the troops were all more or less apt at using it for revetments and blindages. In the latter case, the custom of housing their troops in underground huts made the Turks familiar with such structures, which only required more strength and thicker earth roofs to be proof against everything except unburst shells.

Effect of Fire on Intrenchments.

As regards musketry fire, the results of the wars of 1862-64[2] and 1870-71 had made known the difficulty of carrying well defended works by direct attack, still there was a general belief that it was, somehow, in the power of artillery always to get over this difficulty. Few theories have ever been more completely upset than this was in the late war. But the Russian view at the beginning was even simpler. Because Souvarow had immortalised the superiority of the bayonet[3] they commenced with but little attention to fire tactics. Indeed the infantry, like over-broken dogs, adhered too closely to their peace instructions, based on the economy of ammunition and on individual accuracy; while they hardly waited for any help the artillery fire could give. At Plevna, before the first battle, hardly any time could have been spent by Osman in preparation; and yet the attack beat itself to pieces against the position. In the second attack, the assailant, with nearly double the usual proportion of guns,[4] was equally unsuccessful. He attempted an enveloping move-

[1] In the Asiatic theatre this was less so; there the soil in places is rocky and boulder-covered, and the human hand was often the best intrenching tool.

[2] Hood's repulse at the Allatoona redoubts, with a loss of nearly half the force engaged, and the Federal defeats in the attacks of intrenchments at Atalanta and before Richmond, when, in the attack of Five-Forks they lost 1,100 men in fifteen minutes.

[3] "Poula doura chtick maladiets" ("The bullet is stupid, the bayonet deter-"mined"), was, we are told, his watchword.

[4] 170 in all; of these 40 fired opposite Gravitza at about 2,300 yards range. On the Russian left, the action of their guns was energetic enough, and in some cases they were much advanced, but then their loss in "*personnel*" reduced them to almost entire helplessness.

ment on a line of about 18 miles with 30,000 men; on the decisive points, however, ample numbers were directed, but in formations so close as to entail enormous losses; partial success was obtained against the weaker and more advanced works, but the Turkish redoubts resisted the most persistent attempts, and the defence repulsed the last efforts by taking the offensive.

The failure of the attacks on Plevna had the effect of bringing on the scene the ablest engineer in Europe; and of testing still further what the guns could do. Forty siege guns were got up,[1] and at last 300 pieces were available for the bombardment. These were intrenched in emplacements at measured ranges of 2,300 to 2,600 yards. They were opposed to about 80 guns, and fired for four days previous to the last attack. Todleben puts the loss they caused the Turks at 50 or 60 men a day, in other words, it was a day's work for a battery to wound one Turk.[2] Even Concha's artillery did twice as well at Abarzuza, where a three days' bombardment of the Carlist trenches, with 80 guns, caused a daily loss of two men for every battery engaged. Still it is plain that in both cases, to complete the "work of "demoralization" would, with guns only, have been a matter of time.

The fact is that, owing to the constant attacks they had to stand, the Turks at Plevna were driven into developing, for the first time in the history of field works, a thoroughly sufficient amount of over-head *Cover*. Under this they seem to have suffered less, even from the siege guns, than Rustchuk had previously done from the same pieces. But the want of artillery results was not confined to Plevna; one of the most remarkable instances occurred at Gorni-Doubniak, on the Orchanie road, where Gourko, with 20,000 men and 54 guns, advanced on three lines and made a concentric attack on the two redoubts and outlying shelter trenches that formed the post. The former were much inferior in resisting power to some of those at Plevna, and it seemed, one would have thought, that the guns alone would sweep away not only defenders but defences. The artillery, which surrounded the post, fired for 6 hours at from 2,100 to 1,800 yards and less. The Turks (4,000 men with 4 guns) had to depend on infantry fire.

The Guard came on with a courage beyond all praise. They had been sent for as the "saviours of the army;" unworn by war, unhindered with the pack, they advanced, cheered by their own guns, and fearful only of finding themselves afraid. But when more than a mile from the post their ranks began to thin, struck down by invisible forces that no cover seemed to check: as they reached the zone where rushes alone were possible, each last resting place was marked, as they rose, by a line of dead. Over and over again the clumps of skirmishers advanced to storm the main work; each time the bulk either fell, or fell back: a few reached the steep ditch and there found shelter, and

[1] Of these 20 were 64-pounder bronze B.L.R. howitzers of 32 cwt. from Slobosia before Rustchuk. Todleben did not take command till after the third repulse.

[2] The writer has, quite lately, learned from Osman Pasha, through the kindness of Admiral Hornby, that his loss at the third attack was 3,000 men, so Todleben may have slightly under-estimated the effects of the bombardment.

as the tide ebbed, all the hollows and bits of cover remained tenanted by riflemen.[1] These kept working for the ditch, and at dusk the numbers in it increased. The Turks, unsupported by the army of which they were an outpost, resolved to withdraw, and 5 of the 12 battalions retreated. The defenders of the main redoubt were unable to search the ditch, and the Russians cut footholds in the scarp with their bayonets and bravely stormed the work in the dark. They lost, all told, 3,300 men, capturing some 2,000 Turks. The loss of the latter from fire was small.

Again at *Telische* 5 intrenched battalions, though they afterwards yielded to overwhelming force, alone severely repulsed the first attack. On the other hand, at Loftcha, the care bestowed by Skobelow in posting and intrenching his 56 guns, and the length of time (at least 9 hours) allowed for their action, led to considerable moral effect on the Turkish infantry, which alone was opposed to him; though the actual losses they suffered from the guns, and the damage done to the defences, were insignificant. Nor were the results very different when the Turks were the assailants. On each side it was only where, for strategical or other reasons, the defence was half hearted that the direct attack succeeded. Thus at Kacelevo, the Turkish infantry carried the Russian intrenchments, though in doing so they had to advance 1,100 yards over the open corn fields, because the Russians were uneasy about their main line of retreat, which ran north, *parallel* to their front, and east of the Lom; but at Shipka the most desperate efforts of the assailants were throughout fruitless, and the attack on the position near Chairkeue was not more fortunate. In this case the Turkish artillery entirely failed to support its infantry.[2] Nor again was Suleyman more successful in the direction of Trestenik and Mecka, where his attempts to advance over those open undulating downs, against the hostile intrenchments, in each case ended in failure and heavy loss. While in the totally different country north of Batoum, where, though difficult, the presence of forest and dense undergrowth gave cover to an advance, the defensive positions near Souruhissir resisted all the repeated and systematic attacks of the Russians, who had not, from the neighbourhood of the Adjara mountains, an opportunity of turning the right flank, while the other was secured.[3]

[1] Zeddeler, in his "Practical Conclusions from our last War" ("Voiennyi "Zbornik," May, 1878), mentions that some of these fell asleep under fire, from exhaustion, and were shot as they lay. He says they lost men at 2,500 yards. At this range the bullets fell with a considerable drop (Fig. 7), and this, it is thought, is partly the secret of the moral effect of long range fire. Everyone expects to see men fall when fired at; but there is something "uncanny" in seeing comrades drop down, even behind cover, and apparently without a cause. The effect of the discovery that against long range fire "cover" is "no cover" is very marked in Kouroupatkine's account of the advance of the Kazan regiment against the Turkish second line at Loftcha. At 1,600 or 1,700 yards they took shelter behind small boulders lying in the open; but they soon learned that the bullets found them out.

[2] Col. Sarulchew says the Turkish shells only touched six men, and yet at least 25 to 30 guns were firing for six or seven hours, but at long ranges.

[3] In Asia again, the Russian direct attack at Zevin failed, and so did Moukhtar's frontal attack on the Eshki-Khaliass position, while he in his turn held the Kisil-Tepe against all the direct efforts of the assailant.

These incidents of 1877-78 teach us the increased efficiency of musketry fire and the need for a full development of its power, while as regards field artillery several conclusions are forced upon us.

1st. That long range firing, even at troops or guns in the open, is practically useless, and fails, after a time, in moral effect.

2nd. That against earthworks the frontal fire of field guns, even at reasonable ranges, is unreliable in its results.

3rd. That against troops well provided with blindages, even a long-continued bombardment fails to make way for the attack.

Contrary, therefore, to the opinion generally held after the wars of 1866 and 1870,[1] it would appear that the assailant can, for the future, place but little reliance on this means of success; but, apart from a better tactical use of artillery, improved results may, it is thought, be obtained by a more suitable ordnance; and as, at the present moment, an immediate change to more modern field artillery has become imperative in this country, it is not inopportune to view the question from the standpoint of our subject.

Changes Required in Field Artillery and Small-Arms.

Artillery has open to it two methods of attacking works, *Direct Fire* and *Curved Fire*. The first relying on its small vertical dispersion (Fig. 20), general accuracy, and high energy, aims at striking and cutting through the covering mass. With shelter-trenches the target is so low that the hits are very small, at all but the shorter ranges;[2] while field shells, whether heavy or light, are alike too feeble to cut down the parapets of the larger works. Consequently, "time" shrapnel, with its greater searching power, is the most efficient, except against overhead cover, which, if fairly solid, can resist all the field shells at present in use.[3] As, therefore, the frontal fire of field guns against earthworks is most often useless, the guns should be employed as far as possible for oblique and enfilade fire with *Shrapnel*, (Fig. 22 and Fig. 29, Pl. XVI), and as this involves an increase of range, they should, even if the loss of shell-power be unavoidable,[4] have the greatest mobility so as to be pushed forward as far as possible. For this purpose the German gun of 9 cwt. was, in Turkey at least, far too heavy, while that of 7¾ cwt. got about very well indeed.

For *Shrapnel*, guns should have a flat trajectory, and a very high

[1] After 1866, the Tactical retrospect had formulated the creed, "Nothing can "withstand a powerful preparatory attack by artillery."

[2] At 1,500 yards the vertical dispersion of a field gun is about 3 to 4 feet; at 4,000 yards it becomes 20 to 24 feet.

[3] At Camarli the Russians threw 500 shells into the main redoubt: the full garrison lost only five men. In the Iddis redoubt, the garrison of 1,200 only lost 15 under a heavy and long continued fire of time shrapnel.

[4] Of course, shell for shell, the heavier produce more effect, but if we take the effects of artillery at 4 to 8 per cent. of the whole in war, the difference in weight of shell can not make a difference of 1 or 2 per cent., and this may be balanced by the greater number that can be carried and fired; and by the fact that the light guns are more likely than the heavy, to be in the right place at the right time, while the moral effect is practically the same.

velocity at the *effective ranges*. The former increases the effective range, accuracy, and sweep, and the latter augments the distance up to which the bullets, and those of case, are effective. Further, when guns have to fire at guns, accuracy and sweep are the elements of success.

To simplify the supply of ammunition, only one nature of gun, the light, should, it is thought, be employed :[1] but, while the bulk should be such as suggested, the assailant, it seems, requires an arm with which all weak points, at least, should be assailable. The old smooth-bore howitzer was the outcome of centuries of development. Frederick thoroughly understood its value, and had them in the proportion of 1 to 3; while Napoleon's preference for direct fire proved a loss to him at Waterloo[2] and Borodino. In the late war as we have seen, one weak point of the Russian artillery was that the pieces were "hardly guns and not quite howitzers," and performed the duties of neither thoroughly. In order to attack field works, or the cover given by ground, there seems need for a mobile *Howitzer* of the type of the siege "short gun" intended for curved fire only.[3] For destroying overhead cover, or for battering walls and villages, its shells should carry gun-cotton, as having a much greater shattering effect. The shooting of these pieces is very inferior to guns against vertical marks (Figs. 20 and 21), but compares fairly with them as regards area, such, for instance, as the interiors of redoubts; while their great increase of dispersion at the longer distances points to the desirability of using them at short ranges as far as possible; nor in

[1] The following table shows our present position.

Gun.	Shell.	Muzzle Velocity.	Energy (Muzzle).	Remarks.
Weight in cwts.	lbs.	Feet a second.	Foot Tons.	
6	9	1380	119	English Service.
12¼	16	1365	213	,, ,,
8	13	1560	220	,, Experimental.
7·75	11	1525	181	German Service.
9	15	1460	222	,, ,,
10·5	17·6	1575	302	French Service.
7·5	13·2	1575	227	,, ,,

In taking a new departure with the 13-pounder, and in spite of the known difficulties velocity causes with the carriage, it is a question whether we should be content with beginning almost where others have left off.

[2] He massed 74 *guns* against the English left, at from 1,000 to 800 paces range; with no great effect owing to the ground.

[3] Our present 36 cwt. howitzer, the latest development of the type, throws a 95 lbs. and a 135 lbs. shell; a field howitzer of 10 cwt. should throw shells of 27 and 40 lbs. and now that, with battering guns, against armour plating, the use of gun-cotton has been proved possible as a burster, there should be still less difficulty with the low velocity of howitzer shells in using it with them also. Theoretically, all artillery can alter the drop by varying the charge, while infantry can only do so by varying the range. Practically, field guns cannot do so effectively in action, hence the need for howitzers.

their case is this so difficult, because they can be used behind cover, and need neither see nor be seen (Fig. 23).

For the defence, direct shooting will be the rule, and fewer howitzers will be required. These also may be drawn from the siege trains and will therefore be of greater power, while the shrapnel fire of the heavier guns the defence may employ, will be superior to that of the field guns of the attack. It is now a recognized fact that a proportion of the lighter trench guns at a siege should, for efficiency's sake, be on *Disappearing* carriages; and when such can be made available for the defence of positions, the difficulties of the attack will be largely increased. At Plevna, though the Russian preponderance of guns failed against the defenders, it, in a great measure, forced them to keep shifting their guns, which is always a loss. With disappearing guns this would be avoided.

As regards the *Small-Arm*, the time is not yet come for the introduction of a repeating rifle; though that it will come, there can, we think, be little doubt, because of the great advantage it will confer at that supreme moment, when a nightmare holds men's hands in loading.[1] But the success that attended the crude attempts of the Turks to develop the powers of the small arm, and the admitted shortcomings of the Russians in fire experience, are war lessons that point to the need for most careful and wide-spread peace-training, under conditions as nearly approaching those of war as possible: remembering that only the causes affecting the masses are productive of great results. In the late American war, there were many marksmen in the ranks of the infantry, but they did not counterbalance the general defects, nor does the same quality in our Volunteer force alone suffice.

In these days, when the hordes of half a continent can be armed with the most perfect weapons and be accompanied by all the aid that science has lent to war: hordes too whose simplicity of life gives them much greater living power and no less aptitude for the use of defences than civilized races, while their docility renders them more patient of labour; it behoves *Civilization* to hold her own in every way that preparation, forethought, and superior knowledge can secure.[2]

Effects and Application of Field Works.

By the light of what has preceded we now come to look at the effects

[1] Throughout the late wars, the Turks only used their repeaters as ordinary breech-loaders; the cavalry, even when dismounted, never having come to very close quarters, except in isolated cases. It would appear, by their own account, that the Russians dreaded the arm not a little. Austria is now trying a repeater.

[2] The desirability of knowing how to use the arms of the enemy, has also been seen in the last two wars. The Germans in the investment of Paris made considerable use of the Chassepôt for marksmen, and the Russians this year adopted the Martini-Henry to replace in part the Kranke, as soon as the number they had captured became considerable, while towards the end of the campaign, they partially rearmed their artillery with captured Krupp guns. The interchangeability of ammunition too should be ascertained, because of the quantities sometimes captured. The Egyptian Remington ammunition was found to fit the Turkish Martini, which, however, will not take our cartridge, though we could use theirs.

of field intrenching on tactics and its application in the present state of things.

The tactical questions chiefly influenced by Field Intrenching are—

(1) Manœuvring.
(2) Formations.
(3) Night Attacks.
(4) Supply of the fighting wants, viz., (*a*) Ammunition. (*β*) Food.

Manœuvring. With the improvements in firearms, it early[1] became apparent that the defence gained much by the losses it inflicted on the attack, before the latter could bring its shock to bear: hence the value of manœuvring with a view to preponderance on the decisive point was early perceived, and the advantage of turning movements and flank attacks became apparent. From the introduction of rifled arms, the lessons of each succeeding war made it more plain that, against defences at least, the frontal attack usually failed, and generalship, the art of moving troops, has thus received a new importance. To this, and to superior fire discipline, as well as to their needle-gun, the Prussians owed the successes of 1866, and still more those of 1870–71, while on the offensive. The peculiarity of the war of investments, which later on forced the offensive on the French, at the same time left them no choice but the direct attack; while in the one defensive action fought by the Germans, that on the Lisaine, the assailant failed to carry out a turning movement round Frahir, which his great superiority of numbers suggested, and which must inevitably have rolled up the German right.

The lessons of the war just over, are even more conclusive. In Europe the frontal attack was, on both sides, the prevailing idea, and the loss and failure that followed its use against intrenchments have never perhaps been equalled.[2] In Asia, although the Russians broke down in the early part of the campaign, there was throughout an appreciation, at least, of the value of manœuvring, though, owing to the nature of the country, turning movements had to be very circuitous and generally fell to cavalry and horse artillery to carry out. The former fact made the timing of them very difficult, and the latter lessened their striking power. In the case already referred to at Zevin, the failure of the direct attack was due in a measure to the break-down of an attempt to turn the Turkish right; the troops for this lost their way and failed to strike at the intended moment.[3] The Turkish failure at Chairkeue was somewhat similar. A sufficient force of all arms was directed through the woods against the Russian right, but the want of com-

[1] This was very marked in the XVIIth century, especially under Turenne.

[2] The Shipka is no "Khyber Pass," but an open upland which might easily have been turned by the slightest threat on the Gabrova road, and yet 12,000 of his troops were thrown away by Suleyman, in the direct attacks he persisted in.

[3] An attack on the Turkish left also struck late in the evening, when it was brilliantly repulsed by a small Turkish column, moved out to their flank for the purpose; and almost on the site of *Paskiewitch's* successful flank attack in 1829. At Eshki-Khaliass also, the Russian attempt against the Turkish right was, with their small numbers, an unlikely enterprise, and failed accordingly. Indeed the natural advantages of the position alone saved their own centre.

munications had not been ascertained; the artillery was lost in the tracks, and never supported the attack of the only two battalions that got through into action, and which were met at close quarters by fire from shelter trenches, and by that of case at short ranges. On the other hand, the defeat of Moukhtar Pasha in October, in a position fortified alike by nature and by art, was due mainly to the brilliant turning movement effected by Lazerew; whose column, detached for three days, reached the heights of Orlok in rear of the Turkish left, which was compelled to fall back; thus allowing Heyman to carry the intrenched position of Acolias, the key of the centre; while General Roop retained the Turkish right. In former days, the feat would have been impossible in a country, the difficulties of which can hardly be conceived by those who have not visited it, and was only accomplished through the agency of the field telegraph that linked the operations.[1]

Another instance, but on a smaller scale, occurred at the attack of the Turkish second line at Loftcha. The Turkish right was here turned, while the Russian centre hesitated to close; and at Taghier again, the Russian success was entirely due to the turning of the Turkish right, by the capture of the height (A) which the Turks had failed to hold in sufficient force.

So much for the enhanced value of manœuvring, but the influence of field works is further felt in the power it confers on small bodies of *Retaining* and frustrating hostile movements. So that while the attack more than ever finds it desirable to manœuvre, with a view to turn the defences it can hardly face; an active defender, if he use his advantages, has an increased power of checking such movements.

Then again, the same tendency to enveloping movements, leads on both sides, in the open field at least, to the greatest possible *Extension* of front, and often, in consequence, to the undue weakening of some point. The great extent of his position in front of Kars undoubtedly exposed Moukhtar to be overwhelmed both in flank and centre; and at Deve-Boyun, where the flanks were securely intrenched and held, the weak force in the centre was broken through by Heyman's superior numbers, backed by a cavalry turning movement which struck the Turkish centre in rear.[2] In general, however, the defence is aided in its extension by the greatly increased retaining power of intrenchments; but, on the other hand, they enable the "would be" assailant to secure himself where he likes against counter attacks, while he arranges to strike at the decisive point.

Formations.—Previous to firearms, there was no check on density of formations, except the loss of mobility, and until the rifled period, skirmishers played an unimportant part.[3]

[1] Lazerew's march extended over 40 miles, and the telegraph was laid as he went, with only one accidental interruption of two hours. The line of march crossed and recrossed the Arpa Chai at several points. Our present mountain telegraph train carries (per unit) 30 miles of wire, and 4 stations, on 45 pack horses.

[2] The *ruse* of a cavalry advance concealing an infantry attack, is said to have led the Turks out of their intrenchment to attack the cavalry, consequently they had not time to get back before the lines were carried.

[3] In the smooth-bore period, in attacking field works, a converging fire of

Owing to the influence of the active defence, the attack was, in the beginning of this century, driven to a deep formation of successive lines to secure itself from counter-attack after loss from fire; and the ultimate decision was arrived at by attacking with columns. But with the first use of rifled small-arms, the loss thus entailed was shown each time more forcibly, till the lesson was learned once for all, on the slopes of St. Privat, and the individual order of attack replaced all others. The defence with intrenchments intensifies this necessity. The experience of 1870–71 was roughly formulated as follows:—[1] namely, that the attack entered an unaimed fire zone at 1,000 to 1,200, and upon that of so-called aimed fire at about 600 yards from the defences. In reality, the distinction lay more in the greater sweeping effect at the shorter ranges. Anyhow, as regards the conclusions come to after 1871, in Western Europe at least, the required formation was considered to be somewhat as in Fig. 25.

In 1877–78, though there was little really aimed firing as now understood, the limits affected were considerably extended in the case of the new arms, and, for the future, we may expect that fire will be more or less aimed up to 1,500 or 2,000 yards; for while up to the present time long range fire has fully deserved the name of "unaimed," we may look forward to its becoming more and more the aimed fire of the future; because in the closing scene of a fight, amid the din, smoke, and dire confusion, all that human nature can do is to shoot quick, to shoot low, and to shoot straight, leaving it to the excellence of the arm to do the rest; while at the longer ranges the conditions are less unfavourable to aiming, and it is now known what results can be got, and "how."

The Turks often rather starved their shooting lines: a common formation for their supports was a line of fours at open order in both directions. The Russians, true to their traditions, only in a measure accepted the teaching of the Franco-German and Carlist wars, and looked upon the shooting line as "an irregularity and "excuse for loss of control." Hence its use had not been understood and practised, and their formations for attack were comparatively dense from front to rear (Fig. 26). These small intervals between the several bodies led also to excessive crowding together, and disorganization, and consequent unfitness at the moment of assault. To this too is due the enormous losses they suffered in attacking intrenchments. In Russia, however, public opinion rather favoured this. In this country, if troops *are* expended, not a few think that "somebody ought to be hanged." In Russia, they think so if they be *not* expended. But war is a teacher that will not be denied, and already we see something like the conclusions we had come to after 1871 put forward as the lessons of 1877 (Fig. 27). These are:—

The shooting line is the fighting line.

artillery generally silenced the guns of the defence; and the assaulting infantry had only to cross a zone of 200 yards, exposed to but 4 or 5 shots from each defender; while collateral works, their guns silenced, could not, with short range musketry, give mutual support. Hence at this time the attack was constantly successful.

[1] Zeddeler.

It should be composed of and, at need, reinforced by small *distinct* bodies or squads, each under a leader.

All bodies in rear of the shooting line should be in close formation.[1]

The shooting line should be fed from intermediate supports. Its main body should be further back, and kept as far as possible out of the shooting line.

The other lines should also be further back, and all, even the third, should be deployed in company lines or columns.

The second line, and not the wreck of the first, should be employed for a further advance, when the first has succeeded in the assault.

Positions first gained should be secured against counter-attack.

In advancing, rushes should be avoided as long as possible; as they so much exhaust the men.

As to the best formation for the troops behind the shooting line—the theory of aimed and unaimed fire-zones rather gave a preference to columns at a distance and lines or open lines at close quarters; while lately results show that, at the longer ranges, columns suffer more from aimed fire, Table I. At Gorni-Doubniak the companies in support were in line, while in the attacks at Loftcha and before Plevna they were generally in small columns; and there is a coincidence of opinion as to the latter being best: first, the men are less out of hand, and secondly, covered as they are by the dense smoke-bank that rolls, like a great caterpillar, along the hill-side and shrouds the skirmishers, the columns are practically only exposed to chance fire, at the ranges where aimed fire tells most against *them*: the more so, owing to the low level from which troops in shelter-trenches shoot; and further, in actual fighting, the men at the head of the column in a measure shield those in rear, and so diminish loss.

Night Attacks.—Among the effects of the use of intrenchments, the difficulty of attacking them with their present power of resistance will often make it a question whether the risks of a night attack, or an attack in fog, are not less serious than the certain loss of a frontal attack by daylight. At such times, the shooting qualities (apart from rapidity) of the new arms disappear and the defence is deprived of an element on which it counted.[2] True, the defender has several well-known means of frustrating such attacks, but still, if the assailant can once reach his object, he will have done so at a great saving of loss. No doubt on a large scale, the difficulties of finding the way in every case and of timing the strokes of different bodies are excessive; while in the case of distinct localities, when both sides have been long facing each other, and the distance between them is short, the advantage will lie with the attack. Whenever, as will often be the case, the defender's ground is known to the attack or to some of its leaders, the first risks are much lessened; while fog or moonlight which hinders shooting and yet allows the way to be seen in part, to a great extent diminishes the difficulties. Still the assailant is in

[1] Zeddeler says, as his experience, "I have seen troops in loose order behind the "shooting line, and would rather not see it again."

[2] The Turks used volleys at night, at the third attack on Plevna, but with small results. (Skobelow's report, translated in the "Revue de l'Etranger," No. 390.)

this difficulty: if he assault just before dawn, he has not time to secure his footing, before the defender makes a counter-attack; while if he gain a footing earlier and set to work to intrench, the defender, knowing the ground, can in his turn take advantage of the darkness to close with him, sometimes with a superior force. Of the many facts which impress us in the war of 1877–78 the capture of Kars is, we think, the most important. At first sight it may seem foreign to our subject, but this is not so. The only true distinction between field and permanent works is, that the latter, if they deserve the name, are, as a whole, *storm proof*, while the former are not so, or at least, imperfectly so. Measured by this standard, nearly the whole of the modern Turkish[1] fortress defences are nothing but big field works. Except where the rocky soil stood vertically of itself, or with little building, as was the case in places at Varna and Kars, the new advanced works, though often, it is true, well provided with cover of all kinds inside, were still open to be taken by a rush. It may seem a paradox, but according to our definition, and owing to the accident of the soil, Plevna, as regards the works at least, became more of a fortress than Kars.

At 9 at night, in clear moonlight, about four or five battalions were directed against each of the five principal advanced works of Kars.[2] There was hardly any fire contest, and the assailants lost less than 10 per cent. of the troops engaged; while in the first and second attacks on Plevna, their losses were 32 and 25 per cent.

Night attacks to be successful, require, above everything, excellent discipline and close formations. The Germans, who generally employed a turning movement, succeeded in capturing several defended villages before Belfort by night attacks; while Bourbaki's raw levies failed in two such attempts on the German positions on the Lisaine.

The extreme difficulty of movement in the dark is well known to

[1] Some of the old *enceintes* (Rustchuk, Silistria, Varna, &c.,) had revetted ditches. The new works round Adrianople and those on the Tchekmedje-Derkos lines, though furnished with masonry inside, were, in many cases, as open to assault as the work at Borodino that the French cavalry rode into.

[2] The captured works were Arab Tabia, Kara Dagh, Hafiz Pasha, Kanli, and Suwari. The first two stood on hard rock; were merely large earthbanks, and had *no ditches*. While those of the other three were in earth, and were not obstacles. Kara Dagh was entered at the gorge, under cover of the steep hillside. With the exception of the taking of Kars, the capture of the Kizil Hill, on the 24th—25th of August, 1877, is perhaps the best illustration of the value of a night attack. This sugar-loaf cone, about 800 feet high, stands isolated in the plain of Kuruk, and was held by a Russian battalion and four guns. At 2 A.M., in bright moonlight, 13 Turkish battalions and 12 guns, led by Mehemet Bey, captured it with small loss. The Russians tried to recapture it in the day time, and attacked in force, supported by 100 guns at 2,500 yards, but entirely failed to carry the intrenchments the Turks had made. While a very similar hill, the Nakharji Tepe, of the same height, and held by a Turkish battalion and three guns, repulsed the repeated attempts of the Russians to carry it in *daylight*. Again at Yaslar, on the Lom, the Russians recaptured the village at night, and held it against repeated attacks next day. A night attack, on a small scale, was attempted by the Germans against an advanced work at Belfort. The way was short and rendered clear by moonlight on snow, and they quickly gained the glacis, but the field work chanced to have a scarped ditch, which, small though it was, frustrated the attack.

those who have tried it, and peace practice is here of the greatest use.

Ammunition.—Owing, in these days, to the protracted nature of the fight, particularly when field intrenchments play a part, the supply of ammunition has become a question of the utmost importance (Table V). One great objection raised to breechloaders was that it would be impossible to keep them supplied, and yet in 1866 the Germans only expended altogether nine cartridges per man.[1] In 1870 also they met the difficulty by a rigid fire discipline, which confined the shooting to the very short ranges that suited their arm. The French, who had not thought out the question, allowed themselves much more latitude, and in consequence often ran short, without very great results. The Turks, who had no previous fire discipline, outdid the French in the prodigality of their fire,[2] and in a rough way produced remarkable results (though there was often enormous waste), and further, they were, as a rule, perfectly successful in dealing with supply.

The Russians, in 1877–78, followed in the German wake,[3] and seem to have entered the campaign with an idea that fire was only accessory to shock. They had cut down their regimental transport to 12 ammunition carts for three battalions; and, on several occasions, they ran short in action, notably in Krudener's attack on Plevna, in which a portion of the ammunition column had stuck at Bulgareni, so that in four hours the men had fired all they had. Nor was this an isolated case, for Zeddeler tells us that generally, "the trains had great difficulty in getting within reach of the troops," and he speaks of the "absolute impossibility of supplying ammunition without pack-horses." On the Aladga Dagh, again, which Schelkowmkow had captured, the failure of Russian ammunition is said to have been the cause of its recapture by the Turks,[4] who themselves ran short at Taghier and Eshki-Kaliass.

Our ammunition boxes (each 13½ lbs.) are far too good; and a pack-horse can, in consequence, only carry two, or 1,200 rounds. If we had a solid case cartridge (which is said to give 40 feet additional velocity at the muzzle), we could easily carry 2,000 in waterproof

[1] In the engagement on the Bistritz, the 1st Army Corps fired 12 rounds per man; in one battalion, however, the expenditure was six times as great, and in some companies even greater. At Resonville, in 1870, a French division fired 25 rounds; while in the battles of Metz, the 12th German corps only expended 10 or 11 per man in all. At the Alma our total expenditure was but 2 rounds a man.

[2] Instances occurred, where, on the defensive, battalions fired per man as much as 400 rounds in forty-eight hours (Hain Bogaz Pass), and even in skirmishes of an hour's duration, 50 or 60 cases often lay by the dead.

[3] Their rule was that men should never fire at what they cannot see, and accordingly we are told that some of the guards at Gorni-Doubniak were so disgusted at seeing no results, that they would not fire any more and went on without it. The Russian infantry in 1877–78 expended altogether 25·5 rounds a man in Europe.

[4] The Turks carried little but ammunition and food, so each man managed easily to take 100 to 120 rounds about him. Some ammunition arabas followed the infantry as best they could, but in addition, each battalion, averaging 600 men, had about 30 pack horses, carrying 60,000 rounds (2,000 each). This was the secret of their success. The pack horses were led, in action, by men of each battalion, in rear of the shooting line, with wonderfully little loss, and could go anywhere.

cartouch bags, on one animal, and as the carts are covered,[1] and pigeon-holed, the lightest boxes, or even strong waterproof paper packages, would be sufficient for them. The Turks found their packages stood well enough; they were only of rough deal, over a light zinc case.

The tendency, at present, is to replace individual by mass firing, as far as possible, and thus, among other things, to diminish and control the expenditure,[2] still, from the war of 1877–78, it seems that, though the requirements of a campaign, as to quantity, are generally provided for by existing arrangements, in the actual attack, to meet contingencies, such as the necessity for holding captured posts, the men should each take about 100 rounds into action; and, that a first regimental reserve, on pack horses, must follow them into the fight: then, whatever happens to the carriages, most cases will be provided for, and the infantry is free to use the advantage its mobility confers. For the defence the problem is comparatively easy.[3]

Food, &c.—The campaign of 1877–78 is remarkable for the disuse, in a great measure on both sides, of regular knapsacks. The men carried 3 to 6 days' biscuit and a bag or bundle of clothes: but the distances to be traversed in attacking works is now so long, and the effort so great, that the troops constantly throw away everything: and then there is the risk that, after a successful assault, they are unable to exist on the captured positions; water especially is a difficulty, and its provision, both for attack and defence, cannot be neglected without risk: but the fighting needs should plainly be reduced to a minimum and every effort should be made to stick to them.[4]

Application of Field Intrenching.

We have now considered shortly the bearing of field intrenching on tactics, the subject of its application (both for the attack and defence), naturally divides itself into:—

(i.) Wherewith. (ii.) When. (iii.) Where. (iv.) How.

Wherewith to Intrench.

Among the fighting requirements this question is only next in importance to those of Living and Shooting. Putting aside investments,

[1] These carts should be lighter for difficult countries, and should go "tandem."

[2] In peace manœuvres, the Austrians and Germans find about 36 to 45 rounds per man are enough for an attack; but in war, among other things, men *drop* a great many cartridges.

[3] The Turks kept their infantry in the trenches well supplied with ammunition, and the men who *lived* in them, made little shelves in the plastic clay to hold food and ammunition; for the latter the paper round the cartridges should be put on the shelf, or the clay may stick and clog the action; in some trenches, sheltered cooking places were provided.

[4] Skobelow's forethought in detailing "water" parties for the working and attacking columns at Loftcha and Plevna is very marked. The Turks had a pack horse for water for each company; which enabled them to fortify and hold positions which they must otherwise have abandoned. Thus the Russians, for want of water, had to abandon the great Yagni hill, near Aladja Dagh, after they had captured it. At Zevin, too, Russians left captured trenches to get water. Working parties should have filled water bottles; ours are not large enough for hot weather.

such as those of Plevna, Paris, and Metz, in which the assailant assumes the defensive, it is plain that his use of intrenchments, though much the more limited, requires that, at the shortest notice, the means be always present, *at the right moment and in the right place.*

In former centuries the slowness of operations made it possible to do the work of intrenching by means of gangs of peasants,[1] and later on by battalions of pioneers, while in the beginning of the present century, when movements became more rapid, the comparatively small numbers of bullets fired, and the slight searching power of the arms in use, still rendered accidents of ground generally sufficient for the purposes of the defender. But with the new rifled arms it was soon found that ground alone would not suffice. In the war of 1870–71, although intrenchments played an important part, it is noticeable that in each case almost, except at Spicheren, where shooting trenches were made by the French, there was a fortress or siege base upon which to draw for the necessary means.[2]

The alternatives as to carriage of tools are:—

1. To assign them to technical troops who also do the work.
2. To carry them in battalion waggons.
3. To carry them on pack animals as proposed for ammunition.
4. To have them chiefly carried by the troops themselves.[3]

The first method will no doubt, in part, continue to be used; because technical troops can, owing to their superior training, do certain kinds of work much more quickly and with less labour than others can, and also because their presence in the field is one of the factors that aids the mobility of the whole; hence they will, as far as their numbers permit, accompany the attacking columns in small parties, as they do in siege fighting:[4] but the difficulty, now-a-days, of foreseeing each stage of an action is so great that it may, in the case of any fraction of the troops engaged, be desirable at a moment's notice to have the power of intrenching: so that, as far as the ordinary shooting trenches go, the matter may now be said to be the proper business of the battalions. To meet their requirements, the method of *Battalion Waggons* is that which has of late obtained, and was fairly tested in the war of 1870–71, in which, as already referred to, circumstances favoured wheeled transport to the utmost. That it should have failed, even in France, to meet entirely the rapid and ever shifting emergencies that arose, few could doubt who have watched the deadlock that invariably precedes and accompanies a

[1] Much of the work at Plevna and on the Tchekmedje lines, and the whole of the intrenchments at Adrianople, were made by paid parties of the inhabitants.

[2] The German battalions had each only 30 shovels, 14 picks, and 120 axes, of which 20, 8, and 96 respectively were carried by the men.

The French appear to have had but few intrenching tools, and the tool waggon assigned to each battalion was generally relegated to the general column.

[3] Turenne had his intrenching tools carried by his dragoons.

[4] Zeddeler recommends, what we have already carried out, viz., the attaching of an engineer company to each division to *direct, not to execute*, the necessary works. Skobelow complains that engineer Officers were not attached, to help in fortifying. In November, however, he had a battalion of engineers with his division.

fight: but to supplement other means, wheeled transport will continue to be applied.[1]

Previous to 1877 the Russians had had some tools carried by the troops, but just before the war the regimental tools[2] were *entombed* in waggons assigned to the 3rd echelon of the train. Of the weak points in their organization this proved perhaps the weakest: in fact, whenever there was a call for rapidity, it was a total failure and especially as regards the offensive.

The method of *Pack Transport* is one we are familiar with in India and now systematically use,[3] and in the Peninsula, under Wellington, where we had a more lengthened experience than was obtainable in all the wars of the last decade, the system of the engineer mule trains was found by far the best for the limited requirements of those times.

In 1877–78, the intrenchments of the Turks were chiefly due to the use of this plan; each of the eight companies of a battalion had a packhorse which carried about 16 tools,[4] and, such as they were, they were available *always and everywhere*. In this war, the system proved to be at least better than any other yet tried;[5] but between ammunition, water, and tools, each battalion required 40 to 50 animals, in every way an excessive number; nor must we lose sight of the fact that, as regards intrenching, in the remarkable results of the campaign, time was the principal factor.

Osman it is true, while leaving all else on the road from Widdin, carried on cartridges and tools, and after two days' preparation, gave a very good account of Krudener; but in Turkey every one is a cultivator, and Plevna and the villages aided his resources.

An excellent example occurred in the Turkish advance from Vodica to the fight at Verboka (Pl. XIII), an advance which took about a week. The process is best described as a "rolling" along the surface of the ground, step by step, much more after the manner of a siege, that of a field operation. Had the movement been rapid, the work done in any one or two hours could not have been important; but as it was, the total was considerable. All that was gained, however, in security, was more than lost by the time allowed to the Russians for completing their preparations, already commenced.

Rapidity in striking is, we may be sure, the best weapon of the attack, and in its use of intrenchments the work of numbers must replace that of time; while such action will also enforce imperfect

[1] In 1876, the French decided on a waggon with 70 large shovels, and 40 large picks, to every two battalions; while in 1874, the Germans arranged to carry in the rifle battalion waggons 54 spades, 18 picks, 12 axes, and 27 hatchets.

[2] 360 hatchets, 150 shovels, and 48 picks to a regiment. Skobelow says he had 10 shovels and 3 picks per company (4 to a battalion), a number he found "absolutely "insufficient;" a company often required the shovels allowed for three battalions.

[3] The frontier battalions now moving on Candahar have all their several camel loads of pickaxes and "phaoras." 100 tools on each in wicker crates; the hard rocky ground in the mountains requiring very heavy tools.

[4] Commonly 4 spades, 8 broad picks, and 4 axes.

[5] The Russians after Plevna adopted it with success. At Gorny-Bougarovo for instance it enabled them to intrench and repulse the Turks with a loss of ten times their own. Before Entrepol they intrenched men and guns in one hour.

preparation on the defensive. In retreat especially will this be the case. When Moukhtar Pasha first fell back, though the country favoured defence, he had no time for preparation.

This fact is, we think, at the bottom of the belief now gaining ground, that the tactical use of intrenchments is dependent on the *Carriage by the Troops* of *Portable Tools*. This cannot be called a purely theoretical view, when we find a *Russian* General, writing almost from the battle-field, declare that "if the Government do not give their "infantry a portable shovel, the troops should buy them *at their own* "*cost*." Nor we think will those dissent from him who have seen the struggles, one may well say "agony" of men who, knowing, as none others can, what the ground they hold has cost them to win, think no effort too great so that they may but keep it.

Everywhere in the accounts of the fights at Plevna, at Loftcha, and wherever the attack had to advance and hold its ground, the *want of Tools* was severely felt by the Russians.[1] Skobelow mentions that, in the struggle to hold the redoubts he took on the "Green Hills," the men, enfiladed as they were on both flanks, worked all night with sword-bayonets, canteen-lids, and hands, and even threw the dead into the gaps to bar the Turks.

These facts all point to the same conclusion, namely, that the *Waggon Transport* of tools completely fails, and pack transport *does not meet all Requirements;* how then are the tools to be carried? There is of course a not unreasonable fear that, with tools always at hand, and therefore with an unlimited power of intrenching, the offensive spirit may suffer; but it has now become a question whether the necessity is any longer avoidable, and whether also the consciousness of such power may not even encourage the offensive. On the other hand, there is a solid objection to adding to the soldier's load; still, in 1870, half a million of Germans dragged about a useless sword, as well as the bayonet; we know therefore that a tool of the same weight could have been carried in its place. Since 1871, the plan has at last been tried in war, by one section of the Allied invaders of 1877. The Roumanian infantry soldiers all carried the Leinimann shovel, and with it they not only made field works but actually constructed the siege works at Widdin.[2]

[1] At Loftcha a battalion of the Kazan regiment had to get all the tools of the regiment and those of another battalion as well. The same day two companies of the Revel regiment had to get the whole regimental supply; and in all this shifting, it appears the tools do not somehow come back. Again, even at Plevna, where the assailant had a fixed base to draw from, we find the same. On the 9th of September a battalion of the Esthionia regiment got all the regimental tools to fortify Brestovetz, and these had to be fetched from them in the evening by the other two battalions who had work to do; and again, this regiment and that of Vladimir, told off to fortify the second crest of the "Green Hill," had to get tools from two others.

On the other hand, the Turks, after capturing the Red Hill, near Aladga Dagh, at 2 A.M., by dawn had 13 battalions and 12 guns well intrenched.

[2] Nor are the Roumanians alone in adopting this tool. (Fig. 5.) The Austrians and Danes give one to every file of the infantry. The tool itself is rough and clumsy, the saw is of no use, and the cutting edge soon gets blunt; but there is no question it digs well and can do good work. The carrying arrangement is simple and convenient. The Germans since 1874 have 200 small spades and 40 hatchets carried by each

Admitted that the men can and should carry an intrenching tool, we have to think,

(1.) What they should be. (2.) How to distribute them.

To be efficient, the tool must be fit to be used with the foot,[1] so as in hard soil to do in a measure instead of a pickaxe; for the latter being dependent on weight cannot be made heavy enough and yet very portable. The form should be that which best suits the wearer, even more than the digger; and should be decided on by the battalions themselves. For strength and readiness the tool must be in one piece, and independent of the arms.

The plan of partial *Distribution* has great disadvantages. The American way, namely by rotation, has not been found to work; and even the system of files is an imperfect one. The portable shovels now used all weigh about $2\frac{1}{4}$ lbs., and, all things considered, we should prefer giving a tool of less weight to each man. Even though the general results obtained be less than with fewer and larger tools, there is reason to think they would still be sufficient; and the hardship of having to carry tools would in every way be less felt.

Should it be decided to have the tool thus carried, this question for our army might take the following form, viz.:—

For the *infantry* the bulk of the privates in each battalion to carry the proposed shovel; the remainder a hand axe of the same weight; the actual proportions to depend upon the scene of the campaign. The battalion pioneers to replace their present shovels with pickaxes so as to have more to meet the case of roads or places too hard for the infantry shovel. With the same view, the battalion carriages should carry pickaxes in preference.[2] The present tool carts might carry the men's spare boots and, if possible, clothes, so as to make up to them for the increased weight of ammunition and tools.

Artillery, which is never separated from its transport, and requires

infantry battalion: and this year a Russian Imperial order directs each infantry company to carry 80 Leinimann shovels and 20 hand axes. The Americans in 1862–64 had the tools of a battalion carried in turn by two companies.

[1] For this a length of about 24 inches is required, and a small T handle is desirable. No cover is wanted, but a leather "tab" to take the wear on the tunic would be required. The present infantry shovel can be made as light as 1 lb. 12 oz., but its curved form and length (33 inches) are bad for wear. As, however, the service sword-bayonet of $2\frac{1}{4}$ lbs. is over 29 inches long, a tool of 24 inches in length ought to be manageable. It is a great point not to make it too short, because length more than size affects its digging power. It may be found that the bayonet sheath could be attached to the sling of the tool so that both would hang together, the general balance being adjusted by redistribution of the ammunition. Few spare shovels would be required, the casualties in men being greater, as a rule, than in arms. This form of tool would not of course suit native troops in India. What they require is a sort of heavy hoe, but as this can have a removable helve, the question of its carriage is simplified.

While on the subject of tools, the proved value of the sword-bayonet for clearing the field of fire of grass or branches should not be forgotten. The French have now a universal pattern, lighter than our ordinary bayonet. It makes an admirable side-arm, and if a trifle wider and heavier at the point, it would there have cutting power for clearing, and would be as light and handy as our triangular one.

[2] Each of the carriages, at present, carries 3 tools.

rapid and *deep* intrenching, should adhere to its present arrangements.

Cavalry, which, on detachment, has now so often to act as infantry, might well carry a number of the portable spades.

The *Engineers*, as at present, should be charged with all the heavy tools; but the men should themselves carry tools, commonly those for clearing purposes, and should have a corresponding weight of kit carried for them. Their tool columns should be organized, in part, as in the Peninsula, for pack transport; and could then always be relied on to accompany the advance: this would be especially valuable in the case of turning movements; the timing of which depends so much on the avoidance of unforeseen delays. The remainder to consist as at present of tool waggons of suitable weight.

For ordinary offensive operations, or for hasty defences, the present supply of large tools would, with the tools of the infantry, be fairly sufficient; but to provide for the contingency of an extensive and deliberate use of intrenching, either for defence or investment, such as the construction of numerous redoubts, the intrenching tools assigned to an army corps at a siege should be available, and their transport arranged for.[1]

Assailant's use of Intrenching.

The question of means applies alike to attack and defence, but the "*When*," "*Where*," and "*How*," are best considered separately for each, and first for the attack.

When to Intrench.

The existence of an assailant implies real or supposed superiority: his main object is, as early as he may, to bring this superiority to bear where it will tell most, and his uses of intrenching are merely defensive phases in the tactical work of his strategy. When, for instance, a retaining force assumes the defensive, or when a portion of the line of battle is prepared defensively,[2] with a view to free the bulk of the force for offensive action. Or when, again, as in the case of Plevna, Paris, and Metz, the offensive power of the defender of a strategic position is neutralized by an investment. These cases are in reality defensive ones, and the offensive applications of intrenching are comparatively limited. They consist, generally, in—

(1.) Work of clearing.
(2.) Cover for guns.
(3.) Cover for the protecting infantry and for reserves.

[1] In addition to the regimental tools, the engineers with each English army corps have about 600 picks and as many shovels, and about 500 axes. For a siege 7,500 picks and as many shovels are intended for each army corps, besides the Engineer company tools. From Von Trotha's "Der Kampf um Plevna" we learn that the 25 battalions of a German army corps (in addition to 5,000 small spades carried by the infantry) have 3,000 large spades, 1,000 picks, and 2,500 hatchets immediately available. For the second attack of the "Green Hills" in November, 1877, Skobelow had at last got together 5,000 shovels and other tools for his division. ("Voiennyi Sbornik," September, 1878.)

[2] As was so often done in the late American war, and partly in the days of fighting that preceded Moukhtar's defeat last autumn.

(4.) The intrenching of positions to cover possible retreat and to screen the communications.

(5.) The intrenching of captured ground or positions.

The business of *Clearing the Front* of obstructions to fire, is the one thing the attack cannot dispense with; but in doing so, care should be taken to remove nothing that only conceals, without impeding fire; while objects, such as trees, which the defender may have used as *range points*, should be got rid of at once, and further, any cover close to the guns, which would conceal the approach of skirmishers, should be cleared away as fast as possible. Close to the guns, the gunners can do what they want, while the range-finders are being used; but when clearing is required far forward, the means lie with the engineer troops. In woods, for instance, the labour may be considerable, in addition to that of making ways. Trees and hedges may often be prepared for removal and only cleared away at the moment of firing.

As regards *Cover*, the ever increasing loss that the men and horses of artillery now suffer, chiefly from infantry fire, has made the covering of its living elements an important question for the attack.

When the advance is deliberate and time permits, the methods used by the defensive are the best; but usually the attack has little time for preparation, and its artillery, to be effective, must be pushed so far forward, that the ground it has to fight on may have to be won during the action. Hence, when the surface, or surface objects, give shelter, or concealment, *Natural Cover* must chiefly be relied on. Still, in all the late wars, much use was made of gun pits; without, we think, a corresponding advantage. The assailant's guns, above all things, require the widest possible scope,[1] and as they only fire over 3 feet, a low parapet (Fig. 33) has been used, under the idea that it gave protection. That, except at the shortest ranges, it does not do so is evident, and the results are not worth the labour. The gun is practically no better off than in the open, and the detachment could be rendered more secure with far less work and in far less time.

Among the statistics of 1870, few are more striking than those showing how the artillery losses are composed;[2] from them it appears that the actual risk to the guns themselves is too small to be of any importance, while the loss of men is considerable and of horses excessive. The idea of leaving the gun to itself was half caught in some cases last year (Fig. 24), but, for the attack at least, we would go further, and leaving the guns in the open, would cover the men and

[1] At Plevna, Todleben directed that the emplacements should allow of a sweep of 100° to 120°. In 1877–78 the Russians preferred fighting the guns on the surface (Figs. 24 and 33), while the Turks commonly used sunken pits (Fig. 37); nearly all at Cerkovna and elsewhere on the Lom were of this form.

[2] In the great battles west of Metz, where artillery took a most prominent part, the losses in material were 4 gun carriages, 11 limbers, and 27 wheels destroyed; while those in horses and men were respectively, 2,630 and 1,853. At Gravelotte, 25 per cent. of the men and 75 per cent. of the horses were killed or wounded, and in this case all the guns fought in the open. At Elena in 1877 the Russians lost 9 guns, owing to the destruction of the teams. In 1866, the Germans had only 5, and in 1870–71, 14 field guns dismounted in action.

powder alone. (Figs. 17 to 19.) The guns might then, on level ground, be let recoil several times without being run up, an advantage in rapid firing, and also as allowing part of the detachments to remain under cover for several rounds, while in slow firing, reduced numbers could do the work and so diminish the percentage of loss.

In special cases where protection from oblique or flanking fire is very important, a sunken gun pit, with an epaulment, may be used, the *Gunner Pit* being in the tail of the epaulment (Fig. 42, Pl. XVII).

The above methods are at present those most open to the assailant, in using direct fire; but the constant increase in the accuracy of the gun as a machine, points to the probable adoption of *indirect* laying, even with *direct* fire, when a fixed object, such as a work, is the mark.

A slight raising of the sights (Fig. 36) would in many cases enable guns to be fired by sight, from behind undulations which would conceal them from view and give concealment to their detachments.[1]

For the field *Howitzers*, indirect laying would often allow of their being used at comparatively short ranges and behind *cover* (Fig. 23), which would at the same time screen them from the less searching fire of small arms and guns. This use of a covering mass close to the piece has the further advantage that the assailant can, from positions near at hand, watch the effect of his fire, while the defender cannot, from his ground, see the positions of the guns.[2]

In many cases in France and Turkey, *Cover for Limbers* was also provided, but the labour entailed is so great that they are out of the question in a hasty advance: in such cases it seems better to keep the bulk of the teams well to the rear and flank, though the latter is often impossible when a great line of guns is in action, and to keep the limbers as far off as possible. A large number of cartridges can be put into the cartouche bags, and kept alongside the gunners in their pits, and a supply of shells can, with safety, be laid on a horse-cloth in the open, behind the gun. The replenishing of the supply need then be made *only occasionally*, either by bringing up a limber, or by hand as may be best. The old fear of losing guns, as if they were the *talismans* of victory, has been at the bottom of the custom of placing the limbers and horses in what is always the most exposed position. Much better to guard against the risks of counter-attack by well advanced infantry covering parties, than to be protected against capture by being always ready to run away. Of course there is delay in case of an advance: on the other hand casualties may make advance impossible.

With the increased range of musketry, the positions for *Infantry to Cover* the guns from the counter-attack or fire of skirmishers, should now be much more advanced than formerly. With a view to keeping the hostile musketry 1,400 yards from the guns, some of the infantry should be 600 or 700 yards in front of the flanks of the artillery position or directly in front, if the position be extensive, and here

[1] *See* R. E. Essay of 1876, Fig. 23, Pl. XX.

[2] To take an example of ground at hand, if howitzers were used behind the slope at E (Pl. XII), the defender could not go anywhere whence he could see them, while battery markers by going a little to their left front, could watch each shell as it fell.

we are met with this difficulty, that if the guns be advanced as far as is desirable, such positions for the infantry cannot be occupied without a struggle. In such cases no regular intrenching can be attempted, and this, we think, is one of the many cases in which the infantry shovel will prove so valuable: each man fitting for himself such cover as he has found, similarly when combining the long range fire of infantry parties with that of artillery, on the points of attack, these parties should first improve the posts that are selected as most suitable, so as to be concealed and protected from shrapnel; and, with a view to volley firing, should lodge themselves as compactly as possible. The Russians at Taghier used a screen of cavalry to conceal an infantry intrenching party at work.

Sometimes, when, for instance, an action extends over one day—an occurrence now much more common than of old—the assailant has time to make artificial *Cover for his Reserves.* In this way the Germans sheltered a battalion in column of companies, on the night before Gravelotte, and the Russians, in imitation, made similar arrangements in the open ground west of Plevna. It was intended that each trench should take a company in fours (Fig. 38). Except against musketry at short ranges, this seems useless, and indeed dangerous. The attempt to cover more than one rank should not be made, and columns of short lengths of shelter trenches, in section like the gunner pits, allowing free access to the front and flanks, are required; such sections can also be made much more quickly.

Again, an assailant should beforehand prepare such positions *for Rear Guards* as are necessary to cover the communications, in case of retreat or of a successful counter-attack. Closed works or entrenched localities which command the roads, and prevent them being dominated, are the most suitable. Their construction is purely defensive.

While the above uses of intrenching are desirable for the assailant, the business of securing *Captured Positions* when once gained is all important. The neglect of this was very marked in the second attack on Plevna, when the assailants, after carrying the advanced trenches, rushed on and fell an easy prey to counter-stroke. So too in Skobelow's attacks of the Green Hills, the troops on several occasions advanced to the ridge next beyond the one they were intended to take and hold, thus dislocating the plan of attack. At Loftcha also, when the Russian infantry had carried the first works, and got into the town, instead of making for the *further border* and holding it, they hung about in ignorance of what to do. Now that engagements take place along so great a length of front, and that the general advance is so slow; and also owing to the importance of the fights for localities; ground once gained should be secured instantly, by the troops who have won it, leaving a further advance to fresh troops; and in such cases especially the fact that whoever gets in, every one has some means of working, will be, it is thought, beyond measure important. If the position be required for guns, preparations must be made for them, as was done at Loftcha last year. The evening before the attack, the outlying heights, D and C, by the Selvi Road

were occupied, and the Russians worked all night in preparing 56 emplacements with shelter-trenches in front of them. They cannot, it is true, be said to have been useful, except as a precaution; but at Plevna, on the other hand, in the long drawn fighting that closed the Russian efforts, it was by such means alone that any way was made. These incidents bear so directly on our subject, that we are tempted to refer to them at length.

On the night of the 7th–8th September, the village of Brestovetz was occupied by infantry, to cover the work of intrenching 24 guns, destined to fire against the Krichina redoubts. These guns fired next day till 3 P.M., and then the infantry were directed to attack the "second" crest. This they carried, and even took the third ridge, and advanced beyond it, and over the further slope; but were brought to a standstill, and repulsed by a Turkish counter-attack. Falling back, they made a stand on the second ridge, whence, for lack of tools, they retired to the first, and here, by dint of much "borrowing," some tools were made available, and two lines of trenches were at once commenced. On the 9th this enabled them to resist a counter-attack, which was repeated on the 10th, at dawn, and some hours later, between the 10th and the morning of the 11th, a fresh advance was made, and the second ridge was occupied, and at once intrenched; protected by this, supporting infantry and guns were brought up behind the ridge. At 10 A.M., a column of attack was directed to take and occupy the third ridge. Having done so, for want of better shelter, they tried that of the maize; the musketry fire directed on them reaching even to the reserves, 1,100 yards in rear. These, for lack of means, struggled with bayonets, hands, and canteens, to protect themselves, while waiting the hour of attack. The advanced line tore up the vine roots with their hands, to clear their view, but being without cover, *could not wait*, and gradually drifted on; groups of supports kept joining them, and carrying them to the front, and so the knots of men surged up to and into the nearest redoubts, 36 and 37; of these, No. 36 was open at the gorge, and No. 35 at Krichina fired into it; so when the Turks again advanced, the Russians, to repel them, had to form line *outside*, and there with the few tools they had, threw up two bits of shelter-trench across the Turkish trench. With means to do it, they might have been secured in the redoubts at 5 P.M.; instead of this, all the night long the same struggle to intrench went on. Footings in the counterscarp to use the glacis as a parapet were notched out with sword bayonets, and with these and their hands they tore down the sod traverses and the blindages to barricade the gaps. But with all this, and in spite of the consummate bravery with which they resisted all attacks, they could develop no length of intrenched front with which to repel attacks or to screen their flanks. Hence, with losses too great for them to face the final effort, the works of the defenders had to be abandoned, and the strength of an army corps had been spent for naught. True, the general failure of the attack of the 10th Corps led to an order to abandon the works; but Skobelow, who seems to have been in the front, ascribes the failure, in great measure,

to the want of technical troops, and in general to the absence of tools when required. His experience is, that early in the fight, the soldier throws away the tool he has been given to carry; naturally enough, we think, for in the dismal business of being shot at, the only comfort is to shoot in return, and this a big spade, thrust into one's hand at the last moment, does not help one to do. Something less irksome, and that habit makes a part of themselves, is the only thing men are likely to carry in action. If they cannot carry some such tool, the only alternative in the attack of positions is to assign at least one engineer company to each brigade instead of to each division.

In this stage the actual work to be done, in addition to clearing obstacles, consists of:—

(1.) The making of shooting trenches.
(2.) The adaptation of existing cover.
(3.) The destruction of hostile works.

The first has nothing special about it except that here, if anywhere, time is all-important, and fortunately on this account, the range of fire being here generally short, deep cover is not so needed; but from the nature of the case, troops are much *exposed to flanking fire*, and cover in the form of traverses is constantly required.

The Russian infantry in the capture of the height on the Turkish right at Taghier, actually managed to intrench with stones and rocks, under the fire, at short range, of the Turkish musketry, and under cover of this, drove the Turks from their position.

Against the *Hostile Adaptation* of *Cover*, the defender should have taken thought. When the parapet is not very small, rude lodgments in its exterior slope are often the best. Trenches, not more than $4\frac{1}{2}$ feet deep, can be used at once, and the deeper ones (Fig. 34) can be quickly filled up by cutting down earth as required.

In holding works, the gorge becomes the front, and requires the chief attention: if closed, the parapet should be strengthened, breaches filled, and banquettes for musketry formed. When the assailants are not isolated, gaps through the parapet of the former front and ramps into the ditch, are useful for the entry of reinforcements. The cross shaped traverses used by the Turks give much cover to the assailant when inside; but the blindages are often open to the rear, and portions must be destroyed to "blind" the remainder. The covering of guns, always difficult in works, is in such cases a questionable task.[1]

In village and wood fighting, the further border should be at once reached and barricaded; ordinary methods for hasty preparation being employed. The new defenders must look to their communications and organize a reserve. When villages play a part, their attack can generally be foreseen, and there is then no excuse for not having technical troops with the assault. The more so as in these cases their services are specially useful, and their means more efficient.

[1] Skobelow, it is true, brought altogether 6 light guns into No. 36 redoubt. The men, we are told, were very glad to see them, but it does not appear they were of any great use; they were kept under cover till each counter-attack was developed; 4 were dismounted by the Turkish fire.

Lastly, when the oscillations of a fight bring an assailant on to ground he may lose and again have to retake, the *Works* should be *Destroyed*, as far as time permits, and especially with reference to the time it takes to replace them. Earth parapets can be quickly filled in; and though soon re-made, if the attack be quickly repeated, their destruction may be important. The blindages of redoubts, and their palisades, entanglements and obstacles, which require special materials and time to construct, are those it is most profitable to destroy.[1] But enough has been said to show that, in fights such as *we have* to consider, the fruits of victory must now, more than ever, be held by the labour of those who have won them.

The Defender's use of Intrenchments.

While we have dwelt at some length on the necessity that even the assailant is under, of, at times, using intrenchments, and the more so because the subject has been comparatively neglected, it is of course evident that for the defender, the field for the "*when*" "*where*" "and *how*" is vastly greater.

Among the Germans, whose superior numbers, among other things, in their last two campaigns, led to offensive success, writers make it almost a point of honour to cry down the defensive, as if it were the stupid choice of the worse of two alternatives, and the preparation for it, the

> "Miseræ prœmia rixæ
> "Si rixa est, ubi tu pulsas ego vapulo tantum."

It is better, no doubt, to be the stronger, as most countries have been taught by bitter experience; but in the nature of things, an inferior force, in the open, is the more likely to lose, and to make the best use of "weakness" as the Turkish rank and file strove to do, at least in 1877, is much better than to crumple up at the first stroke of the assailant, as some did in the beginning of this century.

The peculiar circumstances of each case must also be considered; with a nation like ourselves, whose first arm is the navy, the defensive on shore (though by no means to be advocated for its own sake, or where there is a choice between the two), may mean the offensive at sea: and so it was with the Turks. Compared with the invader, they were a great maritime nation, with time all in their favour; and when history comes to weigh the causes of their collapse, politics and persons, not the use of the defensive, will have to bear the blame. That great offensive opportunities occurred is patent to every one; but fitness, as well as will to use them, were on the whole alike absent.

No metropolis in the world has ever been planted on a site so made for tactical defence as that of Constantinople:[2] while, in the Gallipoli peninsula, as if she had not done enough, nature has posted on

[1] The infantry, by dint of numbers only, can, on a large scale, do much; but for these special purposes, the tools carried by the technical troops are required.

[2] The Greek legend is that Colchis (now Skutari) was, of old, called the city of the blind, because no founder who could see, could have ignored the pre-eminent fitness of the opposite site.

its flank one of the best of her own "sea forts," built to be tactically impregnable, and placed to be strategically offensive.

Had it been that, before treachery, exhaustion, and despair had done their work in paralyzing the energies of the nation, the troops of Osman with their leader and those of another leader, *without him*, had strengthened the Tchekmedje lines with their patient labour, and held them with the heroism they in vain displayed elsewhere; with a fleet on each flank, ready to aid them in the offensive, or to assist in supply, and with a railway and the Capital at their back; we think that a page in defensive history might have been written, such as the world has never yet read.

The aim and end of the defensive is simply to "hold ground" and to "gain time," and fortification, which, like gunpowder, consists in the storing up of "work" at leisure, to be used at need, has been, and is becoming more and more valuable as a means to that end. This, however, is subject of course to the quality of the defenders. It was the "hearts" not the ships of "oak," that made England great, and all that art or knowledge can do are poor substitutes for readiness to fight.

When to Intrench.

In answer to the "*when*," the cases in which the defender finds it well to intrench, may, for convenience, be divided into:—

(α.) Offensive—defensive actions.
(β.) Actions of a retaining force.
(γ.) Defence of strategic points.
(δ.) Defence of communications.
(ϵ.) Defence of investing positions.

Offensive—Defensive Actions.—The active defence is generally employed when the forces are somewhat evenly matched. The advantage to the defender is that he may hope to get his opponent to show his hand, and while warding off the blow by his preparations, he retains the initiative for his own stroke. The action fought on the 16th of June last year, at Taghier, is, as regards the intention, a case in point. Mahomed Pasha, knowing that Tergukasow's force at Zedikan was but small, advanced to drive him out. He stopped at Taghier, and the Russians, on the morning of the 15th, were allowed to occupy a commanding ridge (Dram Dagh), in front of, and parallel to, his position. Instead of driving them back, he made some indifferent preparations to intrench a portion of his force. The Russians gave him 24 hours, of which small use was made;[1] attacked him in front with infantry, well supported by artillery, at short range, which fired with telling effect on the rocky slopes, and turned his right flank; this movement enabling them to capture a height on his right, which enfiladed the whole front and made retreat inevitable.

Far different were the results in the skilful hands of our leader in the Peninsula, in such actions as Vimiera and Fuentes D'Onor, when the counter-stroke followed as surely as the stroke; but for our purpose, these cases are less applicable than those where breech-loaders

[1] Only three battalions were intrenched; the lower ground is soft soil.

played a part. The more offensive form of the active defence is the use of intrenchments along part of the front, with a view to, *first*, striking elsewhere in force, and afterwards meeting the hostile counter-stroke by small numbers, aided by these intrenchments.

Retaining Actions.—Delay is the business of a retaining force, in order to give time for a decision elsewhere. In the nature of things, therefore, the force is commonly weak and naturally resorts to labour as a substitute for numbers. Just as Wellington excelled in using the active defence, so there is no parallel in history to the brilliant use of a retaining force made by Napoleon in 1814. On a large scale the army of the Czarewitch facing the Lom, acted, in 1877, as a retaining force to fend off interference with the decision before Plevna; while in Asia, Tergukasow again furnishes us with an example. Five days after the defeat at Taghier, Moukhtar advanced against the Russian left wing, posted on the heights of Eshki-Khaliass (Däir) in order to give time to Heyman to strike with the Russian centre. The steep and terraced ridges, prepared with shooting trenches and boulder-parapets, were well suited for infantry defence; hence, thanks to their preparations, and having only a direct attack to deal with, the defenders held their ground till nightfall, leaving the assailant too crippled for rapid pursuit. The Russian force, true to its mission, after retiring, again took up an intrenched position, three miles in rear, where, had the fortunes of the centre permitted it, they could have made a further stand.

The action of a *Rear-guard* is in its nature that of a retaining force; but, as already suggested, in considering the preparations for attack, the intrenchments for such a force should, if possible, be prepared beforehand; though the infantry intrenching tool would render service in retreat; when "transported," tools are not to be thought of.[1]

Again, cases of retaining action often occur in a *Siege*, when, for instance, an active garrison goes out afield, in order to deny ground to the would-be besieger, or when the besieger in his turn is kept unmolested by the action of an external force. The French garrison of Belfort, in 1870, by the energetic holding of villages, &c., did much in this way to retard the progress of the siege, and the extensive intrenchments of the Turks about Kadi Keue had a similar object; while the careful use of fieldworks by Von Werder's force, not only saved the besiegers of Belfort from being swept away, but prevented results that might have altered the whole campaign.

Strategic points.—A position which invites or compels attack, with the alternative of great inconvenience or risk, may be worth the labour of intrenchment. Circumstances must decide whether an intrenched position or an intrenched camp be necessary for the purpose; when the position is secure against turning movements, as would be the case with the Gallipoli peninsula, the former suffices, and the line of defence may be comparatively short. On the other hand, to

[1] After their precipitate retreat from Plevna, on the failure of the second attack, at the end of July, the Russians, two days later, requisitioned tools from the country and intrenched a rear-guard position, on the hill, by the road north of Porodin. The Yakovitsa intrenchments in rear of Elena alone covered the Russian retreat.

guard against the risk of its being turned, the defensive line may have to envelop the place or position entirely. Thus last year Rasgrad, holding as it did an important position on the Rustchuk-Varna Railway, had to be treated as an intrenched camp, and was fortified with some care; while westward of the Jantra, the effect of the position of Plevna on the other flank of the Russian line of advance (Sistova-Tirnova) became at last the turning point of the war. Placed at the junction of the roads from Widdin, Sistova, Sophia, and Loftcha, from the last of which, itself a point of extreme importance, diverged those to Orchanie, Trojan, and Gabrova, Plevna either threatened or commanded all the lines of advance that were at the time available for the invader, and as long as Loftcha was held, the pressure it caused the Russians was perhaps worth the risk of its isolation. Still, though its retention after it had served its purpose, was, strategically, a great mistake, the tactical success of its defence has hardly ever been equalled.

In considering the defence of strategic points, the changes introduced by the new arms in the *Extent of Modern Intrenched Camps* are very marked. In many cases, as when a group of bridges, an arsenal, or a great railway junction, is the "kernel," the defender's works must of course keep the assailant's artillery at such a distance as to prevent mischief; but apart from this, the diameter of the inclosure, according to the nature of the country, must give security to the reserves, the offensive and most important element of the defence. The general result is expressed in Figs. 40 and 41. The *Condition* in each case is that the assailant's guns be kept at such distances as will prevent their seriously affecting the area it is wished to preserve. In former days this was almost entirely the work of the defender's artillery, and the consequence of its being silenced was, that the assailant could bombard from positions quite close to the defences, even were he unable to assault them; while at present, though the mastery of the assailant's artillery over that of the defence be established, this by no means permits him to close up in the face of an unsubdued infantry, consequently, although, in the first instance, it has become necessary to increase the diameter of the enclosure from about 2 to 3, the retentive power of the modern position is really greater than of the old. Then again, as to numbers, while in former days 10,000 to 12,000 men to a mile of defensible front would not have been excessive for an intrenched camp, we find the Turks accomplished this against a force of more than double the strength, with about 5,000 men to two, and later by 2,000 men to one mile.[1] While, therefore,

[1] If we accept the Russian returns of what they captured at Plevna, namely, 43,000 men and 77 guns, and add 2,000 for the Turkish loss in *killed* on the day of their last sortie, the army of Osman at the time of its surrender cannot have exceeded 45,000 men and 77 guns, on a line of defences 22½ miles in extent, so that it is reasonable to suppose that at the time of the third Russian repulse in September, the defenders did not muster more, and possibly less than 55,000 men, and about 80 guns. At this time the allied forces before Plevna are well known to have been about 85,000 men and 300 guns: while at the time of the surrender, Todleben puts their strength at 120,000 men and 500 guns.

what, for want of a better name, has been called the "arc of defence," is at all events of necessity not more than doubled, the numbers required, per mile, to defend it are only one quarter or a fifth of those required during the smooth-bore period, from which we conclude that an intrenched camp of a size to fulfil modern conditions is defensible by a force only *half* as great as that which was necessary to give similar security before the introduction of the new arms. At the same time, that there is an *Inferior limit* of size is evident, and, if our assumptions be correct, a circumference of about 10 miles, with a garrison of 18,000 to 25,000 men, according as the position and preparations favour defence, is necessary for complete security. The offensive power of even such a force is considerable and can hardly be ignored; should, however, the main object be offensive, some increase in the numbers may be desirable. As to the interval between intrenched camps, in order to close the country between them, it is plain that a long day's march is the limit of the most effective striking distance of each garrison.

In the case of Plevna the commanding position of the Opanets heights especially, and in general the accidents of the ground, made it necessary to embrace a larger extent than the theoretical minimum; but that a diameter of about four miles suffices completely to protect the reserves was, we think, clearly shown by the fact that while the position, measured from Grivica to Blazigas, had an extent of about 14,000 yards, the diameter measured north and south through the town did not much exceed four miles.[1] Again, while owing to the Vid Stream and the height of the banks that dominate the plain, an attack on the Opanets or Blazigas shoulders was not likely to succeed, the saliency of the Grivica position was a source of weakness and naturally invited attack as the defences were here most easily enveloped. In other respects the position was generally favorable.

Defence of Communications.—The new field opened out for manœuvring with a view to avoid the direct attack of prepared positions, gives fresh importance to the holding of communications, as the assailant is now more than ever led by acting on them, to tempt or force the defender out of his vantage ground. The most simple case is that in which circumstances permit the force to plant itself astride or beside the line, and at the same time to have its flanks secured. In a mountainous country this may sometimes be practicable, but the more difficult problem is to secure the use of the communications in a country open to be overrun by hostile forces. The difficulties that attended the attempt in the case of Plevna point, it is thought, to the conclusion that, in the long run, the active co-operation of a field force is absolutely necessary. Posts such as Loftcha, Gorni-Dubniak, Telische, &c., although on a small scale their defence is analogous to that of the strategical points we have been considering, yet have this difference, that it is impossible to give them an extent such as to screen the heart of the post from fire; consequently the *works* of such posts must, in

[1] At Sedan it is true the German guns, on a circle of 4 miles diameter, made themselves felt over the space enclosed, but they were not attacking defences; the crowding of the defenders was extraordinary, and their position hopeless.

combination with the accidents of ground provide the necessary cover for the whole force of defenders: and that too against the possibility of a converging fire. That this was in a great measure accomplished at Gorni-Dubniak is shown by the insignificance of the Turkish loss. At the same time these posts, when in the open, cannot as a rule be expected to do more than act as stand-points and refuges for convoys, more especially against cavalry raids, which, whatever their numbers, are seldom capable of overcoming an obstinate defence.

Defence of Investments.—The last defensive phase we have to consider is that in which the assailant has to neutralize the possible interference of the garrison of a strategical position he cannot capture, by resorting to the tedious and costly process of an investment. He, in his turn, has taken the advantage of being exposed to none but frontal attacks, and, owing to this fact chiefly, no application of the defensive has gained more in power from the introduction of the new arms. At the same time, although we find that the Russians before Plevna successfully maintained the investment with a force never exceeding 3,000 men to the mile; while with 4,000 men to the mile, the Germans repelled the more frequent attacks of the French in Paris; still the great extent[1] of line to be held, makes such calls on the largest armies that one such operation may, for the time, dislocate the whole plan of the campaign. In former days, for reasons already given, such extension was not required, but even then, when the "arc of investment" was but half what it now is, the necessity for providing 12,000 or 14,000 men a mile, for at least 9 miles, gave rise to a need for numbers generally greater, seldom less than those now required; and which was quite beyond the power of the comparatively small armies of past centuries. If, therefore, the defender's power of gaining time by this use of defences has increased, the assailant has now got a method open to him which, though slow, is generally sure, providing other circumstances permit him to wait.

Where to Intrench.

Where to fight in the broader sense is a strategical question, and in this view it may be safely laid down, that the position, whatever be its object, should be as nearly as may be at right angles to the line of communications, when this is not so, the likelihood of disaster increases in case of retreat, and there is a constant temptation to withdraw the artillery too early. This, as already mentioned, was the case in the action at Kacelevo, where, though there was a track to Ablova, the wretched one that did duty for a road towards Stroko was the more important of the two.

Again, whatever be the circumstances that place a force on the defensive, facilities for offensive action must always be aimed at in the choice of positions, but the importance of this varies according to the object of the fight. In the case of an investing force, the choice of ground has rested with the first defender, who will have taken into account how far the position is likely to inconvenience the assailant.

[1] At Paris, Metz, and Plevna, it was 46, 21, and 43 miles respectively, and even in what we have assumed to be the smallest instance will be nearly 18 miles.

Topographically the most common position is the junction of a group of water courses, and this was notably the case in the three remarkable instances we have had occasion to refer to; the general result being that the radiation of the valleys is unfavourable to the communications of the assailant, while frequently giving him commanding ground. Again, when a great town is the "kernel," the communications to it, though radial rather than lateral, greatly aid the assailant, and in France this was peculiarly the case. At Plevna, on the other hand, while the deep system of valleys protected the reserves of both armies, and the absence of wood on the fighting ground gave freedom to the defender's movements, the assailant had his lines cut up by the numerous heights and valleys, in many places wood covered, and on the south particularly by two deep rocky ravines; nor had he the benefit of the excellent roads and railways which in France so aided the invader. In the absence of choice, however, the investment must needs be fitted to the ground.

In cases where the intention of the defence is offensive, the *Position* should be such that the assailant cannot pass it unattacked. It should afford concealment in rear both for posting and moving the troops intended for counter-stroke, which as a rule, on a large scale, is made from a flank; and the ground in front should, at the same time, favour the advance and not aid the original assailant in assuming the defensive, while its defensive capabilities should be such as to secure the line from being turned or broken through during the offensive movement. The positions at Zevin and Taghier were in general somewhat similar. The defender occupied one of several parallel ridges astride the general line of advance, with a deep valley on his right, and with the ground on his left more open and less pronounced. In each case the main attack was directed up the valley, but while in the former the defender, though the weaker force, secured his right from being turned by occupying an advanced post beyond the valley, at Taghier, where the numbers were sufficient, he did not even command this valley from his own side. Had this been done, the position itself favoured an offensive movement from either flank, as there was fair cover in the ravines and there were no woods nor enclosures to hinder free movements. An advance from the left at least, while tending to drive the Russians off their line of retreat, was not much dominated by the ground they occupied; while even one from the Turkish right did not present more difficulties than were overcome by the Russians.

For the defensive, the *Local Requirements* for the position are:—

(1.) The greatest possible field for fire against all attack.

(2.) Security from being turned or outflanked, and also from being *much* overlooked.

As regards the actual fighting ground, the labour of preparation is diminished if—

(α.) There be marked features either of ground or on the ground to act as decisive points.

(β.) Unbroken communications along and to the rear.

(γ.) A surface *favourable* for moving guns and for intrenching. While the capabilities are increased in proportion as there is—

(δ.) Depth of position so that the defence of the supporting lines may be kept clear from, and be not involved in, that of the shooting line.

(ϵ.) An obstacle under fire, covering the portions of the front that are purely defensive.

(η.) A surface that deadens the effect of artillery fire, and conceals the "strike" of musketry.

Negative Advantages.—The negative advantages, namely, the hindrance of the attack, are also important. These may consist in—

(θ.) The difficulty of approach.

(ι.) Obstacles separating the attacking fractions.

(κ.) Unfavourable fighting positions for them.

(λ.) Exposure of their distant movements.

The Fire Zone.—In touching more especially on musketry fire, an attempt has been made to show that even since 1870-71 its zone has largely increased; and it is at the *longer* ranges that aimed mass fire is most likely to play a part against works, owing to its greater searching power and to its being less perturbed. In 1870, as far as musketry was concerned, the Germans were content with a clear field of 300 to 400 yards, but although the difficulty of crossing this is now greater than ever, the defender, who cannot use his musketry over a much greater area, will not be getting all he can out of his advantages; in fact, with each arm, the power to shoot at least up to its most effective limit should always be striven for, with as little artificial help as may be. For artillery especially, and for infantry, except at short ranges, some command of ground is an advantage. The natural form of ground (and in Turkey this was remarkably the case) is an increasing slope from foot to crest (Fig. 45, Pl. XVIII). This is a less favourable condition for shooting than a straight slope, and accounts for the diminution of intensity often noticed in the fire of works, as the assailants near them. In defending the deep ravines at Plevna, for instance, the men, when required to shoot at short ranges, had to expose themselves most at the moment the hostile fire was most telling, and in consequence (Fig. 59, Pl. XIX) naturally fired "over." At Loftcha, it was noticed that the Russian infantry suffered most at a distance, and lost hardly any men on the steep bare slope of 200 yards that rose to the central work on the "Red Hill."

For close defence, ground with even a slight fall to the works is the *most favourable* for shooting, while the searching power of short range fire, as against the works, is slight.

The Flanks.—The ground tends to security against turning movements in so far as—

First. It presents difficulties to the advance against a flank.
Second. It overlooks and exposes the movement to fire.
Third. It offers physical difficulties to the assault.

For the first, the Chairkeue action is a case in point; the turning of

the Russian right was rendered very difficult by the fact that the assailant's advance lay through almost trackless woods.

For the second, the position intrenched at Zevin furnishes an example, commanding, as it did, a full view of the hostile advance.

The same position equally illustrates the third. For while physical difficulties protected the right flank from capture, the more open nature of the country on the left exposed that flank so much that Paskiewitch owed his victory here in 1829 to his flank attack on the Turkish left. At Taghier on the other hand, though nature had supplied the "difficulty," the neglect to intrench the height A led to its being captured; and this again to a wider cavalry turning movement which rendered the defeat a disaster.

The advantage of some command and the inconvenience of being commanded are respectively illustrated by the two actions just referred to. In the first the Russians were always overlooked; in the second their position overlooked that of the Turks. For this reason too, the Batoum position has for centuries been a battle-field,[1] overlooking as it does the wide flat plain of the Cholok.

Decisive Points.—Each increase in the effective range of arms has brought with it an increased tendency to "localize" defence. Thus the engineer, even were it now possible, no longer encloses a fortress with continuous works, but employs detached forts or groups of forts; and in their way field defences must be similarly disposed. The weakness of the defence lies in the assailant's power of attacking where he will; and the more the former is concentrated on a few strong points, the less field of choice is left to the attack. In open country, commanding heights, defensible woods, or suitable ground may be turned into decisive points, with but little labour and in short time. In 1877 the Opanets and Grivica positions at Plevna, and the conical hills on the battle-fields of Taghier and Aladja Dagh, and along the Suroulisser position before Batoum,[2] naturally formed decisive points; while in 1870–71, villages, enclosures, and woods were the "field forts of defence."[3] In the investments of Paris and Metz, their name was legion. At Gravelotte the "Point du Jour" and the farm of Moscow, and Héricourt and Montbéliard on the Lisaine are well known instances.

Communications.—The right use of the offensive element in the defence, namely the handling of the reserves, is evidently dependent on the means of moving rapidly and safely; and, if possible, unseen by the enemy. As the fighting front should be, and is as a rule, astride the lines of approach, in a close country, lateral communications

[1] The presence of old Georgian castles, of Genoese and Venetian posts, and later still of half obliterated Turkish intrenchments, show the secular importance of this fighting ground.

[2] Those about the Aladja mountains average 800 or 900 feet in height, at Suroulisser they are from 100 to 500 feet high.

[3] In dealing with our subject it has been thought most profitable to avoid detailed reference to village and wood fighting, because the last war has added hardly anything to our experience on these subjects, which have moreover been dealt with very fully by the light of 1870–71, in the Précis of Tactics: Col. Schaw's pamphlet on Field Intrenching: also touched on in the R. E. Essay of 1875.

are seldom abundant; and even where woods are absent, lateral ravines and streams cut through the position, and isolate the defensive sections. This was Von Verder's chief difficulty in the covering action before Belfort, owing to the ravines; and on the Turkish position before Batoum, both woods and accidents of ground made intercommunication devious and its preparation troublesome. Indeed, whenever the natural features are very marked, this is generally the case. The Turks having tools always at hand were very quick and industrious in opening up woods. The day after the fight at Kacelevo they were hard at work cutting tracks, while the Russians had done little on the same spot for weeks.

Nature of the Surface and Soil.—The nature of the surface soil, whether hard or apt to work into mud, affects especially the movement of artillery into position. Its effect on the rate of intrenching is also a point to be thought of. Soil that, at the same time, is easily dug and stands at a steep slope is the most convenient for blindages and the larger ditches; it holds water, however, and is difficult to drain. As a matter of fact, sandy soil offers a resistance to missiles, at least a third greater than that of ordinary earth.

Depth of Position.—The difficulty of retiring from captured intrenchments, and re-forming again a short distance in rear, renders the second line of defences very apt to be "rushed" by the assailants following on the heels of the defenders, unless sufficient space separates the lines.[1] The ground must in each case be considered, thus (Fig. 45) when there is a gentle reverse slope, unseen from the front, the shooting line may be at the crest and the second line down the slope.

In the next case (Fig. 46), which is not unlike that at Chairkeue, a more forward position is better. In the third, the position of the first line, if not exposed to musketry from the border of the wood, is not unfavourable, as the assailants will be prevented by the second line from debouching with guns, or from intrenching at leisure beyond the border (Fig. 47). In the ordinary case of a plateau, the shooting line would be on the brow, but if very wide, the position may be retired, so as to use the plateau as a foreground.

Protecting Obstacles.—In all positions there are certain parts marked out by circumstances for pure defence, and these are the more strong if covered by an obstacle *which their fire commands.* The Lisaine and Allaine streams thus covered the front of the position before Belfort, and as the defenders were not in force enough to act offensively, they were on the whole an advantage. The Russian left at Chairkeue was, in a measure, protected by the stream in front,[2] and at Plevna and Zevin one section of the defender's lines was thus effectually secured. Against a hurried attack, impassable *Forests* form effectual obstacles; but when the attack has time, ways can be cut through them.

[1] This happened in a measure in attacking the Turkish second line at Loftcha; and at Hafiz Pasha redoubt before Kars, the Russians entered along with the repulsed troops of a sortie.

[2] Some of the Turkish infantry carried down fascines to fill up the channel; they were too small to be of much use.

Of all obstacles, *Cliffs* are least reliable, and require to be always watched. It is difficult to see why the Russians, unless they were surprised at Kacelovo, neglected to hold a sufficiently forward position to command the steep rocky ravine between Solenik and Kostanca, formed by the white Lom (itself impassable), up which the Turks in part advanced to the attack. At Zevin and Eshki-Khaliass, however, the precipitous ground made assault difficult. At the former, men, when shot, rolled right down the slopes.

Against *Night* attacks, efficient obstacles are valuable aids; because they narrow the lines of advance, which, in consequence, can be guarded, without too great calls on the men.

The Fighting Surface.—The effects of artillery particularly, and generally of all missiles, vary with the surface. Rocky surfaces, as at Zevin and Taghier, ensure the burst and increase the effect of shells; while in the soft, loose soil, like that at Plevna, Kadikeue, and Batoum, shells are buried in their craters, and shrapnel and splinters do not ricochet much. Bullets, on the other hand, flatten on rock, and the effect of their ricochet is lost. Another point with musketry fire is the new importance, owing to the increase of range, of surfaces which allow the *strike* to be observed from a distance.[1] Dry earth is the most, and growth covered, or wet earth, the least favourable on this account.

Negative Advantages.—In deciding where to intrench, the difficulties the attack will have in engaging the works is an important question. The more the assailants are separated, impeded, badly placed, and exposed, the easier the defender's task. The assailant on the Banika Lom laboured under all these disadvantages. The heads of his attack had to work through woods, along imperfect roads or tracks unfit for wheels. Then the bend of the stream nearly at right angles to the defender's front and the width of its valley isolated the left from the centre, and made joint action difficult.[2] Nor were the fighting positions, when reached, at all favourable. The infantry was exposed a good deal, on the right and centre, at 3,000 to 4,000 yards from the defenders; while here, as well as at Zevin, the only artillery positions were too retired and so situated as to be very inefficient.

When the ground is clear and the defensive position dominates the surrounding country, the assailant's strength, dispositions, and movements, in the day-time, give early notice of his intentions. This point brings us to another, namely, the value of artificial observatories.

There is something acrobatic about *Balloons* that has, up to this time, prejudiced their military use; and added to this, there is a popular belief that if struck by a shell, they must fall like a stone; but when it is remembered that one can safely run down 600 or 700 feet with a valve of 3 square feet, *wide open*, this fear may be dismissed, and does not

[1] General Tchebitchew, in a recent article in the "Invalide Russe," on indirect musketry fire, says he has noticed the strike of the Berdan bullet on a turfless parapet, at 1,670 yards, with glasses. The writer has noticed the *splash* of shrapnel in action at a greater range.

[2] The Allaine in front of Montbéliard would have had a somewhat similar effect had the French moved in force on both its banks: but it would have caused less inconvenience than the valley and Red Lom together did in 1877. (*See* R.E. Essay of 1875, Plate I.)

trouble any one of experience. Those who have watched in an action, how the issues turn on a knowledge of the hostile movements, or of the hostile works, must often have longed for 600 feet of vantage, whence to overlook both armies, and so ward off, or direct, the coming blow; and, this is the power that, except in storm, a field balloon supplies, coupled with the advantage of mobility.[1] On the whole the defence is both the more likely to be able to make the necessary preparations, and to benefit by the power of sight; because it would, in great measure, disclose the dispositions and therefore the plans of the attack, and so deprive the assailant of the advantage he reaps from surprise. On the other hand, the assailant would often greatly gain by a knowledge of the defender's resources which may be concealed by the ground: the disposal of the reserves, for instance, or of unseen works would affect his plans; while in both cases, when the curved fire of artillery is used, the balloon observatory would help to regulate it, and give its use a much wider field. We cannot therefore doubt that this, like other inventions that at first seem unpractical, will come to play a not unimportant part in the fighting of the future.

How to Intrench.

The war just over was one in which field intrenching was an ever present element in the fights; so much so that public feeling, which after the Crimean war was by some led to look upon earth works as a "new discovery," has on this occasion been brought to fancy that the Turks had hit on some, till now, unknown way of using intrenchments. This is very far from being the case; the technical lessons of the war of 1870-71 were, on the whole, much the more valuable, because they indicated, for the first time, the necessities of the new state of things in such a way, that to those who had studied them, the results of the last war due to intrenching could have been predicted with certainty. That intrenching was much more largely used in 1877 than in 1870 is, in addition to the causes already touched on, due chiefly to the presence for the first time with infantry of an ever ready though small supply of tools. Up to the introduction of the rifled arms, the idea that field works were in part

[1] Except during firing, a telephone worked by a telegraphic cord by the cable of the balloon, will enable the observer to "tell" what he sees, on the instant, at head quarters: he himself being, if necessary, questioned by the same means: while if supplied with copies of the map, whatever is observed can, at once, be noted on them and slid down by the cable, written information being sent down in the same way. The practicability of making hydrogen in the field has been proved in the American war of 1862-64. What is required is a moderately portable arrangement for the purpose; fit for wood fuel, and which can be worked with, or within a few days of, the army; and a supply of small reservoir-balloons, of heavy, strong material, to hold 1,000 feet and to carry the gas about the country, so as to accompany the light cart, or even the pack horses that could take the observing balloon or pair of balloons. Even when full, very large balloons can be shifted 10 or 20 miles along the surface by 3 or 4 men, so there is no difficulty in carrying up the small reservoir ones, or even the field balloon of 10,000 to 12,000 feet. The heaviest part of one of these is about 130 lbs.

useful as obstacles was always clung to. The appearance of the "shelter trench" marked the abandonment of this view; but before the war of 1870, no one had thought practically of the effects and results of long range fire; and consequently, by way of not impeding the offensive, very small and shallow trenches were proposed. In 1870, and still more in 1877, necessity soon gave birth to a deeper type, and one no longer continuous, so that the gaps formed the lines of advance for guns and cavalry. Indeed the assailant has distinctly gained by the necessity, now imposed on the defence, of providing more laborious defences, and defences too that can less and less be subjected to reverse fire when captured. The Turks did not trouble their minds about this latter, less indeed than the Russians. Their works were defensively the better, but gave the attack more cover when taken. In their hasty work, they, to suit themselves, gave their trenches such a width that the men, as is their wont, could *squat* in them; but on the whole they differed but little from those used in France. What they did do, was to make an excellent use of tiers of musketry fire, often in a way that would have shocked the mind of Chatham: but they had a sound military instinct, that, provided it did not disturb the others, it mattered little if a few men, more or less, were shot in the back so that the general defence succeeded.

The idea of combining huts with shooting trenches (Fig. 30) in exposed positions, is also happy; but we must look to the more deliberate preparations for what, we think, was the most important feature in their work, namely the great development of overhead cover. Few lessons of the war of 1870 had been more obvious than the necessity for this; but though in 1870 the construction was better than in 1877, the use of it was much more limited.[1] The use of traverses too at Plevna, particularly where they were cross shaped, was efficient as regards defence, and naturally grew from the Turkish practice of lowering the whole interior space of their works: by placing blindages in all the angles of these, they had cover against all-round fire; so however had the successful assailant, Skobelow for instance, after the capture of redoubts 36 and 37.

One practice of both Turkish and Russian infantry is worth mentioning, in order that it may be avoided; that is the custom, when the trenches are manned before an action, of laying the rifles with fixed bayonets conspicuously on the parapets. Through this, the most happily concealed trenches became apparent to the reconnoitring staff; and the artillery need ask no better mark. The Russians, too, found their breech action often got clogged in this way. The bright

[1] The Turks certainly had some queer arrangements. The practice of making the exterior slopes of works a steep turf revetment was unaccountable, unless with the idea that shell splinters would then be less likely to come back on men in the ditch or glacis. The common practice too of putting rifle pits 20 or 30 yards before the shooting trenches must have been a relic of siege traditions, as men could not stay in them in action while they were far too close for outposts at any time, and would have been useless, as such, at night. Similar pits, where there was any fall of ground, were occupied, directly before the gun-pits, and what between friendly "prematures" and hostile "unders," the situation of the infantry occupants bordered on the precarious.

bronze of the Russian guns also often discovered their emplacements[1] when otherwise invisible against a good background.

The Disposition.—The disposition and execution of the defensive works are the elements of the "How."

While, with a view to the greatest development of fire, the general front is more or less covered with shooting trenches, at intervals suitable for forward movements, the defensive framework is now composed of one or more lines of well defined, strong posts, or decisive points. When villages, woods, and enclosures are available, they can be turned to account without much labour; because the numbers required to defend such posts, namely about one man to a pace, are about double what are required for the preparation. Failing these, earthworks must be used, and these take four or five times as many men to make, as to defend.

The division of labour in fighting consists in assigning to the defenders of the shooting trenches the chief business of combating the assailant's frontal attack with their fire, while, should they fail in repulsing him, the more storm-proof defences, whether villages or closed earthworks, then come into play to resist the final rush. And here, it is thought, a new consideration comes in; while formerly the decisive points had chiefly to fear the fire of the hostile artillery in the beginning of the fight, and at that period suffered but little from musketry, in the future there is every reason to expect that the converging fire tactics of the artillery will be also adopted by fractions of the hostile infantry. For just as guns magnetise guns, so exposed or prominent redoubts, or other strong posts, magnetise infantry; consequently when these are seen from a distance, they will, for the future, be subject to a very searching and efficient infantry fire, in addition to the fire of shells. It would appear therefore that the keeps of the position should, for choice, be generally sheltered by the ground, somewhat as at K, in Fig. 49, and their *Defence Reserved.* This would protect them from direct gun fire and long range aimed musketry fire. In 1870, the French attack on the line of investment along the Villejuif Plateau, south of Paris, was accompanied by so powerful a fire that it cleared the defenders off the plateau; but the defended post, formed by the village of Thäis,[2] in a hollow at the south-east shoulder, was thus sheltered, and consequently offered an unimpaired and unexpected resistance, which checked the attack.

The *Advanced Trenches*, which present only a low target and no *area*, are not so much affected by long range fire, because, while the defenders are actually shooting, the gain in searching power affects them less than dimunition of sweep; but with works of any depth, the interior spaces no longer give *security* when exposed from a distance.

It may be argued that the redoubts at Plevna, all situated on the dominant and exposed points, yet answered their purpose well enough. In the first place it is a question whether the success of Skobelow's

[1] The Krupp guns were browned and much less conspicuous. The absence of "glitter" is now as noticeable in the French army, as before 1870 the contrary was the case; even their bayonet scabbards are of browned steel.

[2] *See* R.E. Essay of 1875, Plate VIII.

assault of the two redoubts he captured was not in a manner due to the continued exposure of their garrisons; and also it must be borne in mind that these Turkish keeps were very numerous (three to a mile on the average), and had been the fruit of months of preparation, which resulted in the provision of cover that met almost all contingencies. It is perfectly true that works might have been made of equal efficiency in a very short time, but the capacity for doing this has never yet been exhibited on a large scale by any army in the field, and as long as, either from want of skill or want of time, proper preparations cannot be made except at leisure, it will be much better to resort to the method of concealment for posts of this kind. These decisive points, like that of Saint Privat, at Gravelotte, will naturally be those which, from their position, invite or even compel attack, and they may therefore be covered in front by obstacles, without impeding the offensive movements of the defender, which, with a view to striking on the flank,[1] rather than encountering the front of the hostile advance, will be made from *between* them, not *from* them; but as the space required for the advance of a brigade is not much more than one-third of a mile, there is almost always much more than ample room, and this gives the defender the great advantage of acting offensively at any point in the line, and with the special troops for the purpose.

In smooth-bore days it was held[2] that *Decisive Points* might, if well defended by artillery, be at intervals of 1,600 yards. At present this is about the limit of interval for musketry defence, while between powerful artillery positions the interval may safely be double or treble, when the ground is all clear and exposed. Thus between the works on the Blazigas shoulder at Plevna and the group on the Opanets heights, there was a clear 3,000 yards; while from the Opanets position, which was exceptionally strong, and the works at Bucova, the almost unfortified interval was 4,000 yards, which was evidently quite secure. At the same time some intermediate intrenchments are always desirable, as otherwise the assailant can in a measure envelop the main points with his fire.

The *Second Line* of defence, which is not intended to be the fighting line, but rather a defensive reserve, is composed of similar strong points, if possible dominating those in front, or facing the intervals between them. The limit of effective musketry fire seems to be the best distance between the lines, as with less distance, the defenders of the front position, if driven out, can hardly reform, and may compromise the defence of the second line. The Russian retired works between Dolny-Dubniak and Netropol represented a second line of defence, but were 1,200 to 1,500 yards behind the first.

So much for the main line. Where suitable *Advanced Posts* exist, or can be readily formed before the main line, and within supporting

[1] The Turkish counter-attack from their *left* at Zevin is a successful instance against an unintrenched assailant, while the brilliant and persistent counter-attacks, in the neighbourhood of the Krichina position, though they failed to carry the works of investment, denied to the assailant the possibility of establishing himself in the captured positions, and were the veritable soul of the defence.

[2] "Memoirs of Marshal Saxe."

distance of its fire, they increase the difficulties of the attack, which must deploy earlier in their presence and capture them, or be taken in flank by them. The stone farm of Saint Hubert, before Gravelotte, the fortified hillock called Mougnot, before Héricourt, and the small oak wood marked M before the Russian position at Verboka are instances. The last was occupied by the Russian infantry, and might have played an important part, but being somewhat dominated by the guns[1] above Cerkovna, they were driven out by the central attack.

Advanced posts should be so commanded from the *Main Position* as to be untenable by an enemy, even if he carry them, while to be of much use they should be capable of resisting, after they are in part surrounded. The Turks were rather fond of putting advanced shelter trenches 400 to 600 yards before their main defences;[2] but these proved no substitutes for advanced posts, as they had constantly to be abandoned, and although, in their case, it was generally done with coolness, it by no means follows that other troops can do the same without great risk. Advanced posts on a flank are a great protection against turning movements. The hill-top held on the Turkish right, at Zevin, made all the difference between the defender's position there, and that at Taghier. In addition to advanced posts, the defender's advanced guards which would be 1,000 to 2,000 yards to the front will often use light intrenchments, open at the gorges. The strongest advanced guards would be those to cover an exposed flank.

As regards the posting of the *Defender's Guns*, the employment of these for mass fire is never so marked as with the attack, and the use of the artillery mass by the defence is more often confined to the defensive reserve artillery, at the decisive moment.

Seeing that the action of the guns is likely to be impeded, if not stopped, should the assailant's infantry get to close quarters, the chief field for their use is the delay and loss they cause the assailant in the earlier stages; hence the most *Dominant Points* where guns are secure from being enfiladed, should be assigned to the artillery, so as to aid them in concentrating on the lines of approach, and in driving the attack to deploy early, and also because retirement *above* the general level is, as regards safety, in a measure equivalent to retirement from the front.[3] Such positions, however, seldom supply the gently sloping foregrounds which are most suitable for artillery fire; hence in the closer stages of the attack the positions should allow of a cross fire, directed along the general front. This has the advantage of mutual support, and of not bringing the guns into a frontal contest with infantry, and also does not demand so much depression. In such cases accidents of ground (Fig. 52) may be convenient as saving the labour

[1] A rocket battery also fired into it, from above Cerkovna: it may have had a moral effect on the enemy; it certainly had on us.

[2] These trenches had, however, the advantage of keeping back the assailants' guns by their fire, just as advanced posts do.

[3] At Beaugency, the French guns at Cornay, behind the crests, are said to have been beyond the reach of the Bavarian guns in the plains below (Seubert's account). At the Kizil Tepe, already mentioned, 100 guns, at effective range, failed to silence the two Turkish batteries, and the 13 battalions that held it.

of artificial protection. Natural or made obstacles, such as rocks, water, or felled timber, protecting the artillery positions, are always desirable, as, even in the case of an advance, the reserve artillery, not the position guns, would be employed.

As a rule, when the ground favours mobility and the teams for withdrawing the pieces can be kept under cover and at hand, the fight will be begun by a proportion of guns in the most advanced points in the open, and with only gunner pits for the detachments. Should the infantry fire threaten to silence them completely, some of these guns can then be withdrawn into emplacements got ready for them in the main artillery position, which it is thought should now be about 400 or 600 yards in rear of the shooting line, except when suitable accidents of ground secure them in more advanced positions. The assailant's infantry will then be fully engaged with that of the defence, at a distance of about 900 yards, or 1,400 from the guns, and will in consequence be little likely to interfere with them.

The way the Russian guns were intrenched and worked in the fight at Chairkeue was very creditable. At first, those in the left batteries (5, 4, 3), were engaged with the Turkish guns, and, at the moment of opening fire, showed, by their accuracy, they had had the ranges measured. Soon the right batteries opened to their front, on the Turkish infantry of the right attack. The ill-timed centre attack next debouched from Cerkovna, and these batteries were directed on its skirmishing line, while the left batteries were instantly turned off the Turkish guns and changed to shrapnel fire at short ranges against the infantry.[1] Late in the day the guns in the centre batteries fired across the whole front, to enfilade, in a measure, those the Turks had advanced to C to support their right attack.

The moral effect of *Long-range* from a very commanding point, is, now and then, in itself important. At the action of Karahassan-keue, the Turks got two light guns on the dominant bluff, called Sahar Tepe, whence they looked down on the Russians in the basin of the Lom, at a distance of at least 4,000 yards. The material effect, had they fired for a week, would have been nil, but there was no mistake about an effect being produced. This power is especially valuable on exposed flanks. The want of guns on the Turkish right at Taghier, though it could not seriously affect the capture of the Col, at all events permitted the Russians to make a separate and somewhat wider turning movement, with their cavalry in close formation, and thus to strike a much more compromising blow. The western slope of the Col would have offered good alternative positions for guns for this purpose, where, as at C, they would have been traversed from the frontal fire of the hostile artillery.

The posts or works of *Rear-guard Positions* should, in general, be disposed so as to secure the greatest retaining power, and in these it is well to have some guns in order to check the hostile artillery from

[1] With, it must be admitted, extremely small effect, though the time fuzes burst fairly enough. The effect of depression, however, was equivalent in loss of sweep to increased range. (Fig. 3, Pl. VIII.)

closing on the retreat.[1] Accidents of ground, to cover cavalry, are desirable in the neighbourhood of the works.[2]

Execution of Works.—The kind of works to be thrown up must depend—1st. On the Time; 2nd. On the Means.

Whatever be the means, the time available, or that can be calculated on, fixes what should be attempted. However short the time, the work of clearing the foreground and of making the necessary lateral communications, such as gaps in walls or hedges, or woods, must be carried out in preference to everything else, as on them the tactical conduct of the fight may often depend. If less than 10 to 18 hours of actual work be available, field redoubts of any value cannot be made; and even with a full day, they can only be made when the execution of such work is thoroughly understood. Indeed, owing to technical ignorance, no attempts were made during the late war to construct such works, except where weeks rather than days were available. For this reason a power of quick decision as to what to do, when to do it, and with what means, is the great secret of rapid and effective work; and practice alone develops this.[3]

In the more hasty preparations, woods, villages, and railway features combined with trenches and gun pits, are the works best fitted to the time, and in most of these respects, civilized countries aid the defender by providing the means of forming strong posts hastily, while in an uninclosed country, redoubts must be resorted to.[4]

With our present organization for *Infantry tools*, supposing they are ready when wanted, two companies from each battalion would have the means of working; but, as already stated, experience shows the system is unreliable. Should the plan of supplying the battalions with portable tools be adopted, there can be no question about the means for doing all the lighter, and much of the heavier work of intrenching with them. Roughly speaking, a fair shooting trench can be made, with a section of 8 to 12 square feet: now with the present infantry picket shovel, about 40 cubic feet can be excavated in easy soil, in an hour, for one hour only: and it follows beyond all doubt that with a portable shovel, each man can excavate at least 25 cubic feet in an hour, or if the files have each to do two paces of trench, and work alternately by very short spells, they can in that time make

[1] Guns that must stay till taken: as so many of the Austrian guns did, to their credit, at Sadowa.

[2] The chances that occur for cavalry were well shown in Skobelow's retreat from the captured redoubts, on the 11th September. The Turkish infantry, which advanced right through theRussian skirmishers, were taken in flank by a sotnia of Cossacks, hid behind a fold in the ground, and suffered severely (Skobelow's report). At Zevin, Turkish cavalry repeatedly charged Russian unbroken infantry.

[3] Much time is saved, if the Officers who are to superintend the larger works can be sent to the ground beforehand. When the position is in one's own hands, the works can be roughly marked out, by the help of the cavalry escort, with pickets or cuts in the turf: but in a hostile country this may not be convenient, and then it is best to fix some salient point by two compass bearings, on some distant object, or by the alignment of pairs of suitable objects, and take and note it and the bearings of the faces, &c., on a hand sketch. Then obliterated marks can be recovered; or, if anything happen to the Officer, others can use his work.

[4] But the enclosed country, for all that, is the best for the attack.

ample cover for two to shoot. As a rule, of course, a battalion would hardly ever be all extended, but the companies in support and reserve if about to be exposed to fire, require shelter trenches, as much as the skirmishers require shooting trenches, and the universal presence of tools will facilitate this in open positions; while in a close wooded country, all the men with axes and a proportion of the others, will be employed in clearing, or in arranging obstacles. Even in the making of large earthworks, the first reliefs, without difficulty, and if necessary the whole, can be and have been done,[1] with these small tools: but, though it is wasteful of labour to employ them when the large intrenching tools come up, still these will almost always be at least 1 or 2 reliefs of 4 or 5 hours in rear of the troops, and, a relief saved, often makes the difference between readiness and the reverse.

Exclusive of the preparation of villages, woods, and railway works,[2] the remaining subjects are—

(1.) Clearing.
(2.) Preparing shooting trenches.
(3.) Preparing Redoubts.
(4.) Preparing Cover for guns.

The work of *Clearing* to the front is, in our army, done by the technical troops aided by infantry working parties when necessary. In cutting down woods, large single trees are often conveniently left as observatories in which to post sentries. When the stuff is small it may be cut down only partly, so as to form entanglements, which impede, without protecting an advance. In all cases of "felling" the direction of fall should be "against" the attack.

The late war was singularly barren of incidents in wood fighting, the oak woods being generally impassable except along the tracks.[3]

In the making of *Shooting Trenches* the first point is to fix the exact line. If the surface is to be the banquette, then by looking over the muzzle of a rifle, set upright on the ground (Fig. 56), it can be seen how far the crest may be retired from a slope it is required to sweep; and with lower parapets, the same can be done by grasping the rifle at the height of the proposed crest and looking over the hand, thus the hand half way between the bands gives the height for men kneeling. The best level for standing can only be decided on on the spot; the higher the banquette the better you see to the front, but the more you are seen, and the higher the mark, guns have to aim at. The Russians at Chairkeue used admirably concealed deep trenches, with the earth thrown away to the rear, and at Zevin, where shells would have had an awkward effect on the stony earth, the main line of trenches was similar to Fig. 34, B, only with no bank in rear.

[1] In the recent trials at Arras. We may with them calculate on from 40 to 60 cubic feet in each relief of 4 or 5 hours, according to the soil, and in proportion as the depth of excavation is small, while with the large tools nearly double this may be obtained.

[2] The defensive works on the Turkish railways were few and far between. The plateau near Keu-Luli-Bourgas, made by nature to cover the great Maritza bridges, was not touched, while Adrianople was being belaboured. North of Vetova, the Rustchuk railway was defended by a few shelter trenches, astride the line.

[3] In woods of weak young trees, cavalry can often force through, where infantry have great difficulties.

In many other places, however, the surface of the ground was used to stand on, and between these two extremes, there were any number of varieties.[1]

The relief of the trench necessary for cover, is decided by the drop of the projectiles at the ranges from which the assailant can fire, and it is plain that the longer the range, the more "height," and the less thickness is necessary, and this is even more so against oblique gun fire (Fig. 29), when the path of the shell has more to cut through. The protection of the men firing is enhanced by *bonnettes*[2] of earth, or by log, trough, or wicker loop holes, particularly when the slope in front is steep. As a rule, steep slopes cannot be defended with certainty by the direct fire of intrenchments, because, even if seen, the men, in the effort to save themselves at the moment of assault, fire too high, if they fire at all; but by adopting a mutually flanking arrangement, this is avoided (Fig. 59). On some of the steep "Cols" of the Batoum position, many of the defenders could not see the slope before them, and relied mutually on the neighbouring works.

Shelter trenches hastily made are often, in themselves, all that can be done, but as they now form an integral part of even semi-permanent defences, it has become necessary to provide them with some overhead cover against the searching effects of oblique shrapnel or of very long range musketry or mitrailleur fire.

Subject to the power of shooting, shelter trenches should be concealed as far as possible; where this cannot be, nothing is simpler than to make overhead cover, when timber is at hand for instant use (Fig. 51), and in such case the possession, by each company, of some cutting tools will be found very convenient. With strong timbers such blindages act also as ramps and take the place of gaps in the line.[3] Timber, however, is generally scarce, though brushwood may be plentiful, and this can be worked up into hurdles, while fascines, made entirely of the thickest stakes, well tied together, act as substitutes for baulks, if placed either touching, or with hurdles on top covered with earth. And here we would go further even than was done in 1877, when such blindages as were made, were intended to resist shells. The main blindages of redoubts should do so, no doubt, when means exist; but with a view to the further use of cover, the bulk of the shelter should only have roof enough to keep out bullets and shrapnel. It therefore becomes a question as to the least protection required. We know from trial, that the musket bullet penetrates near the muzzle, from 10 inches of sand to 20 inches of marly clay, and goes through about 12 1-inch planks, while at over 3,000 yards one of these is penetrated.[4] We may safely assume therefore

[1] It may be safely said that the sections used in 1870–71 and 1877–78 were seldom as good, and in no cases better or simpler than those in our latest text books.

[2] With bonnettes, one foot high, on musketry parapets the percentage of hits is only $\frac{1}{4}$th what it would otherwise be (Olmutz and Krems experiments 1870–71). The Russians, before Plevna, found the colour of sand bags was too conspicuous, they daubed them with mud and covered them with earth.

[3] The timbers should have a long bearing on the solid, or the earth breaks in.

[4] This is due in a measure to the falling velocity; for, from 1,800 yards onwards, the loss of penetration is very slight. The harder the material, the more nearly does

that at long ranges, the bullets will not go through more than 6 to 7 inches of earth, and as their path is oblique, this thickness should suffice. From Brialmont's experiments[1] we also know that a field shrapnel ball with about 1,000 feet velocity at the burst, goes through 4 to 8 inches of sandy earth. It is therefore safe to assume that at the longer ranges, at which alone the drop is very searching, 8 inches of earth roof will suffice. In such cases, short lengths of the trench, provided with open "*bullet sheds*" (Fig. 50), or hurdle arches (Fig. 43) will screen the defender when not actually shooting. These portions of the trench are best made somewhat curved forward in plan. If the line be but little exposed to shells, a hurdle roof (Fig. 53) will protect men while firing, against dropping musketry or shrapnel bullets.

In the defence, it is important to have the immediate *Supports* of the shooting line at hand, but to do so, brings them as much as, or more than the latter, into a fire-swept zone (Pl. IX). They therefore require shelter trenches, in rear of the shooting line. When only exposed to direct fire, deep open trenches suffice when they can be made; but against oblique fire, overhead cover is becoming more and more necessary. This differs from that described for the shooting trenches in being somewhat wider when the material permits, and in having ample means of exit; or when much exposed as on descending slopes, in having oblique or covered approaches (Fig. 54) connecting the supports with the shooting trenches. Open bullet sheds are perhaps the best cover for supports, and should be made and placed so that an assailant could not use them to fire out of if captured, which he cannot do from those arched or blinded completely.

For the *Reserves*, ground may often be turned to account, and shelter from musketry be provided for by means of light roofs (Figs. 55 and 58).

We now come to consider *Field Redoubts*, a class of works that has lately played an important part. The general features of the Turkish redoubts at Plevna, of which so much has been said, and which are typical of their works in general, were, a plan of 4 to 6 sides each 30 to 60 feet long, a trace rarely giving any flank defence: The whole of the interior sunk 2 or 3 feet and filled up with a large central traverse (often cross shaped, or forming a gorge parados) provided with shelter-sheds or blindages, in rear or in the angles, while a number of blindages were formed under the banquettes of the parapets and their traverses; and occasionally, under the counter-scarps. The latter, however, were abandoned towards the end. The parapets were 6 to 10 feet high, and up to 20 feet thick. The ditches 10 to 20 feet wide, and up to 10 feet in depth. The scarps and counter-scarps generally very steep. There was no flank defence of the ditches, and

the loss of penetration vary as the square of the velocity. The penetration of the M.H. bullet at 300 yards is about double that at 1,000 yards. The penetration from 0 to 500 yards falls off in the proportion of 5 to 3, the velocity being as 1,350 to 890 F.S. (Table IV). This however is not so with earth; owing to deformation, the highest velocity is said not to give the greatest penetration into it.

[1] This was at a range of 930 yards: large fragments of shell will, near the burst, go through a little more, but these, like whole shells, do not affect the general results.

few obstacles in them, but the well known plan[1] of employing the ditches as shooting trenches was used; steps being cut in the counterscarps, and sometimes in the scarps, for the men to get up; or else a shooting trench was cut in front of the ditch and steps were used at intervals. In the section given by Todleben, the Turks are represented as having had a tier of riflemen, for indirect fire on the berm. This can have been but rarely the case, because when the attack was distant enough for indirect fire, these troops could have been employed more conveniently outside the ditch: while indirect fire from behind the inner traverses, would, at other times, have been as convenient, and more secure, *if ever required*. As a rule, the defensive use of indirect musketry fire is properly confined to the troops in the shooting trenches. The redoubts were intended for from 2 to 6 guns, and in a rude way, the Austrian plan of providing cover into which to lower them when not in action, was employed. Protection was also given by making the traverses several feet higher than the parapets. A great deal of gabion and hurdle, and some sandbag revetments were employed. The guns fired through embrasures, sometimes as deep as 7 feet, and with revetted cheeks: these were mostly in the *faces*, not the flanks of the redoubts. These redoubts give but an imperfect indication of the rapid use of such defences in the field, because they were the work of much time, and of daily experience of what was wanted: but they showed conclusively the enormous resisting power of such constructions, when manned by determined infantry, provided with ample cover:[2] for while many instances occurred in the war of 1877 of shelter trenches being carried, the capture of redoubts was much more rare, and then, in nearly every case, it resulted from troops getting into the ditches, and assaulting from them.

Although their resisting power has increased, still the new development of indirect musketry fire, even more than that of shrapnel, makes the fighting of redoubts more dependent than of old on their proper construction: their trace, while kept as shallow as possible in the main direction of fire (Fig. 22), must be laid out entirely with reference to the ground, and to the conditions of mutual defence: some excellent examples are to be seen in the disposition of the works at Plevna. As a rule, they were placed at the heads of valleys, or in positions to enfilade them and give mutual support. Thus 25, 27, 28, and 32 mutually flanked each other, while 29 and 30 swept the ground in rear, and 26 and 31 acted as keeps. As to size, redoubts intended to play an important part should, it is thought, be fit for at least 2 companies, allowing about 4 men for every 3 paces of perimeter, and even this is small: those of larger size should be fit for a wing, or a battalion.[3]

[1] R. E. Essay, 1875 (Fig. 32, Pl. VI).

[2] In 1873 the Russians experimented with a square redoubt with the interior space filled with shelter trenches parallel to the front. These, it was found, gave cover from shrapnel fire, but not from curved shell fire. The conclusion come to was that the gorge and flanks required continuous parados.

[3] These are infantry redoubts. General Von Hannenken in discussing the influence of intrenching as shown in 1877, proposes that infantry battalions should make redoubts themselves, and *afterwards* have them finished by the technical

When the ground does not require command in order to see to shoot, lowness of profile has the advantage of attracting less attention, and of affording a less conspicuous mark. At Plevna, the works made a great show, partly from the colour of the soil, and partly from the ground: this is always a disadvantage, because redoubts, as the visible symbols of the opposition to be overcome, exert a magnetic power on attacking infantry; of course the interior space is less protected with low works, but the arrangements that sufficed in former times to cover the defenders, no longer hold good; and overhead cover must in any case be employed: hence the height of the parapet is now of less consequence, provided the blindages can be made.

As regards *Thickness of Parapet*, with field shells, any that strike further back than 4 or 5 feet from the crest, produce no effect; because, if the drop be slight, they ricochet, and if considerable, they burst after penetrating only 2 or 3 feet: hence the labour of making parapets more than 10 or 12 feet thick is out of proportion to the gain.[1] The ditches are the weak point of field redoubts. They are seldom an obstacle, and in such cases as we have seen at Gorni-Dubniak and Plevna,[2] they become rallying places for the assailant, and even in steep-standing soil, the men in time cut their way up with their bayonets.

As to the *Flanking of Ditches;* with timber, and a couple of days, or less, there is nothing to prevent the making of efficient machine gun caponiers which fit into the narrowest ditches. In the absence of mitrailleurs, a ditch 20 feet wide, wide enough for a caponier for 10 or 12 rifles should be made when time permits. The formation (or rather absence of formation) of the assailant, as he closes in the modern fight, leads to the entry of but few men into the ditch at any one moment: consequently a few rifles would *now* generally suffice for its protection.[3] The roofs of these caponiers are perfectly safe from direct fire, and the chance of their being hit by howitzer-fire is small; to be secure against it, they should either be protected from a drop of 20°, or have extra thickness of roof planted with abatis (Fig. 69) to prevent its forming a bridge. Even without the delay and difficulty of these sunken constructions, or when drainage would prevent them, something else may be done. Admitting, as we now must, that unflanked ditches are no obstacle, nothing much is lost by using surface caponiers (Fig. 65). It is true they form bridges into the work, but they are, at all events, narrow and defensible from the parapet. At a distance they would not show from the front, and the chances of

troops. This is a bad arrangement, because the whole work should progress together, and with the blindages, &c., the excavations must sometimes be made before the making of the parapets. By postponing such work, even when it can be done afterwards, there is the probability of its not being done at all; and in such case the infantry results are worse than useless, because they give a sense of security that will fail in the proof.

[1] In the much battered works of Plevna, it was found best to revet only the lower two-thirds of the interior slope, shells bursting near the crest did less harm.

[2] Cf. Skobelow's attack, where he captured the redoubts from the ditches.

[3] Should repeater rifles form part of the armament of the defenders, they would be very suitable in such positions.

their being injured by oblique fire are small. They would of course deny the ditch as a lodgment; and may be worth making when haste is required. These, however, want about 3 reliefs. A more hasty method is, when it can be got, to fill in the ditch with vertical abatis, which is a serious obstacle.[1] But after all, the infantry soldier is the best obstacle, and the covered way, at the shoulders, should (Fig. 57) be arranged to allow the reserves to come up, under cover along the flanks, to fire into the ditches of the faces, while shooting places at the gorge ends of the flank ditches supply the means of protecting them. With these precautions, even hastily made redoubts should be tenable.

The plan of continuing the flanking shooting trenches along the edge of the glacis of the faces of the redoubts, with steps from it into the ditch, seems a good way of getting two *Tiers of Fire;* and the ditch provides a safe place during the bombardment; but with caponiers, the line of retreat of the defenders, should be by the flanks, and they should be out of the ditch altogether.

In the Russian plan of providing two tiers of fire (Fig. 64) the defenders of the advanced trench had to retreat by the gorge or get up over the parapet. They are well placed for shooting, but if the assailants reach the counterscarp, they would be somewhat overlooked. They attempted to flank the ditches from these (Fig. 63) by making them salient at the shoulders, but the method appears for this reason uncertain, because the 3 or 4 men available might be shot from the glacis; still it would be better than nothing in such cases as that of Gorni-Dubniak, particularly if a covered passage to each lodgment ran direct into the work.

The great increase of effective musketry range, and its consequent enveloping power, now exposes the flanks of works, much more than formerly, to reverse fire: hence they now require *Parados* (Fig. 67) as well as traverses.[2]

The way of securing the *Gorges* of field works, is one of the most vexed questions, because the conditions are irreconcileable. The defender wants to make it as difficult as possible for the assailant to get in, and as easy as possible to drive him out, should he succeed in entering.

When the redoubt is on a commanding point, and there are no works or positions in rear, whence to fire into it, the best plan is to stay in it and to aim at the first object only. In such case a section of gorge somewhat like Fig. 65 will give most security against capture. At night, the bank M gives a vantage ground, and in the day-time a second tier of fire; while the whole is flanked by a surface caponier, and protected by a ditch, if the soil make it worth while. On the other hand, when the redoubt is backed up by a second line, which cannot, however, see over a parados, such as just described, the gorge may be formed by alternate sections, Fig. 61; the unroofed part being about two thirds to three quarters of the whole length.

[1] It is worth remembering that the preserved-meat tins, now so largely used for feeding troops, come in well as hand grenades. The engineers carry fuze to fire them; and can occasionally spare gun-cotton for bursters.

[2] The parados may also be used for a second tier of fire over the flank.

This will leave such large gaps, that the whole of the interior will practically be exposed to fire. When there is not time for the larger blindages in which the defenders of the gorge can take shelter, while the frontal attack progresses, then bullet-shelters must be resorted to in parts (Fig. 62); so that some at least of the defenders may be ready to shoot, even under curved fire from the front. These arrangements, of course, require to be supplemented by covered communications between the parts of the work, and sometimes by others to the rear, whence the garrison can be re-inforced by reserves placed under cover, when it has not been possible to make cover for the whole garrison in the work itself, or when redoubts are chiefly used as gun batteries, and it is thought desirable to keep the infantry defenders outside till the assault. The Turks generally placed any local reserves that remained outside, about 100 yards to the rear[1].

As to the question of putting *Guns in Redoubts*, an European authority, writing this year, argues that the Turkish use of redoubts at Plevna shows the soundness of doing so: that they successfully withdrew nearly all the guns out of the few works that were captured; and that Skobelow showed he believed in the plan of mixed defence, because he brought several guns into one of the two works he took. The Turks did a good many queer things and succeeded nevertheless. As to the withdrawal of guns, it is difficult to see how the possibility of doing so is an advantage; it was done both at Plevna and at the Alma it is true, but in many cases the ground will not permit the bringing up of the teams, and nothing indicates the *beginning of the end* more ominously to the people who are to stay, than the withdrawal of the visible signs of strength: even were it not so, it is such a business that it disorganizes defence, while it goes on; and it further silences the guns at the time they may be most wanted. Skobelow's experience cannot be said to be happy: of the 6 guns he brought in or captured, 5 were dismounted. The fact is that the defence having chiefly moving marks to aim at, must, except in the case of an investment, confine itself to the use of direct fire; and requires emplacements to permit of a wide field of fire. With field carriages, which must chiefly be used, it is a matter of extreme difficulty to make emplacements which give, at the same time, cover and sweep. If the guns be in a position to shoot all round, they are dismounted, if not they are often only *lumber*. In isolated positions, which must be self-contained, guns must sometimes be included, and then the plan of running them down under cover is the least inconvenient. The difficulties are almost entirely removed when some of the disappearing guns from the siege trains are available. These may be placed between the parados and parapets, in the flanks and under shelter of traverses (Fig. 67) they can then be used suddenly with great advantage, in the close defence.[2]

The bulk of the defensive artillery would, however, appear to be

[1] They had probably not heard of the capture of the Düppel redoubts while their garrisons were outside; and generally managed to be up in time themselves.

[2] It may be objected that they must thus be built in: we think this an advantage, as they are then sure to stay. They can be dug out when the defence ends.

placed to greatest advantage in more retired and, if possible, more commanding positions, between the decisive points, the close defence of which is chiefly an affair of musketry. The emplacements for these retired guns may be of the field type, or, on very important points, closed and storm-proof gun batteries protected, almost entirely, by external infantry reserves, may be used. Indeed, as may be judged from their small size, this was the function of many of the more retired redoubts of the Plevna positions; as is evident from the fact that the blindages for the gunners only were, in the first instance, provided. Whenever guns are placed in closed works, it should be done with the clear intention of leaving them there throughout the fight, while in the more open emplacements they may be constantly shifted. In these too they attract less attention, and are consequently less often overwhelmed. In the first and second battles before Plevna, the Turks made considerable use of *Spare Emplacements*, and threw up a great many, so as to be able to shift rapidly into them, with each change in the progress of the fight. When this is done, each set of emplacements may be made for a particular purpose, and precautions can be taken against flank and oblique fire. A gun, for instance, might, in the beginning of the attack, fight in the open at F to the right of the pit (Fig. 42), and then, for flank fire to its left, be run into the pit and be sheltered from the front.

With field carriages, additional protection can only be got by firing *through* a high parapet, and with a limited field; but when the defence draws on the siege trains for part of its guns, high carriages are available, which fire over an efficient parapet, and the emplacements are then made of the siege type. In a few instances in the late war, for example, at Kisil-tépe in Armenia, and in the defence of the Orchanie pass in Europe, guns were put into blinded pits (Fig. 66), but the plan is troublesome, and chiefly useful against concentric musketry only, because any shells hitting short enough to strike the uncovered gun, would generally damage the embrasure of the covered one. When concealed behind corn or plants, they are, however, very suitable for the close defence of important points, such as redoubts a little in front of them, because they have then to fire chiefly in one direction, and have to deal chiefly with musketry; and the men have a great sense of security in them.

Conclusions.

Intrenching is only one of many important Elements in War.—The temptation to the specialist is always to give undue weight to that fraction of the whole which is the object of his interest, and the effect of this on intrenching has been, that while some have weakened the case by valuing it overmuch, others have been inclined to ignore it altogether. In truth, with an army in the field, the difficulties of living and moving are great beyond the comprehension of all but the actors; and such is the exhaustion of energy, that what would in peace time be but slight additional efforts, are, in war, magnified into great ones; hence the inclination is to look upon intrenching as not worth

the labour, the more so that, now-a-days, the chances that call for instant action are so often recurring, that the strain on the whole mass is almost unceasing. Nothing therefore but a clear understanding of the value and use of intrenching, spread universally through our Army, will *at the commencement* of war, secure its use, though later on experience will teach its necessity.

The salient points of the question at this moment appear to be—

The Attack has gained Strategically, the Defence Tactically.—Looked at as a whole, or strategically, the vast increase in the power of arms has made whichever may be the stronger, now more than ever strong; and at the same time it has, on the field of battle, greatly increased the relative powers of defence; but, while the last great war has confirmed the fact, that when defenders mean to stay, and can only be got at "straight," they generally *will* stay; it has also shown that, after all, there is a limit to the effect of fire, and that whenever the attack has been pressed home, some at least have reached the goal, and that, too, in a mood that gives them tenfold force. For so intense is the strain of being every instant face to face with death perhaps for a whole long hour, that the desire to end it anyhow gives an impulse beyond the gauge of rules, and that thrusts men on, as if safety only lay before them. This show of resolve reacts on the defenders and, at the end, would tend to shake their purpose, but that their losses when intrenched are so small, and those they inflict are so great, that most often the contest is unequally in their favour.

Development of Manœuvring and of Front.—The tactical gain of the defence has forced upon the attack the necessity for manœuvring, to strike in flank rather than in front, and this leads, on both sides, to the great extension of front now usual. Again, the great losses of the offensive lead to the more frequent use of *Night Attacks.*

Influence of Musketry.—There has been and is a steady increase in the relative importance of musketry fire, which has made it beyond all question the decisive arm, while protection from it has become the first object in intrenching. The development of a system of musketry bombardment may now be looked for, and will lead the defence to avoid its effects, by concealment generally, and chiefly in the case of the decisive strongholds, so as to diminish, as far as possible, the disadvantage of immobility.

Influence of Artillery.—The "preparing" power of artillery, when opposed to intrenchments, would appear to be less than was thought, from the results of 1866 and 1870. The distance to which guns are relegated by musketry fire, has been, and is still, increasing, and the need for improving their shooting, for using them in mass, and for oblique and enfilade fire, has become, if possible, more apparent.

Earlier Deployment.—The great increase in effective range of aimed musketry, and the considerable searching power it now shares with shrapnel, have made it necessary for the assailant largely to increase the distance of his deployment, and to confine himself to the use of small fractions for the advance; while the defender is now led to increase the relief of the shooting trenches, and to consider how to provide over-head cover with the smallest means, and those most often

to be got, and further to confine this, in a great measure, to protection against the small arm and shrapnel.

Fewer Works now Required.—While the labour of preparation has been increased in detail, the reliability and range of musketry defence has increased the safe intervals between works, and so has diminished their number, and further has given the power of flanking obstacles at a much greater distance than of old.

To strike and to parry have always been the alternatives in war:—

For the first is required fitness in arms.

For the second aptness in intrenching.

Fire having become the great arbiter in the fight, the need for *Fire Discipline* and of a thorough knowledge of what the arms can do, is now of vital importance to all combatants. To the assailant, because by fire alone he can hope to win; to the defender, both for the sake of the power it gives and to know how best to paralyze its effects. Nor indeed is the defender any longer alone concerned in the latter question. The present "hiatus" between the "veni," the "vidi," and the "vici," is no longer what it was in the Gallic wars; and the assailant, both in the opening and closing stages of the fight, now finds time, and thinks it well, to betake himself to intrenchment.

Success depends on Quickness.—Again, the great increase in mobility makes quickness the first object in preparation, and this adds increased value to the sure and ever present supply of means for work where wanted. When these exist, the progress of invasion is now delayed in a way before unknown; provided always that the troops engaged have, during peace, had a little practice in the making of works, and that the directing staff have had a very great deal. Without this, the work of days may extend into weeks, and the great advantages that intrenchments can confer may be, in consequence, entirely lost.

As the moral of the late war, a German General has just put the question to his countrymen: "*Is our army instructed in the attack and "defence of field works, and is it duly equipped for the purpose.*" In view of the not unclouded future that would seem to be in store for this country, may *we* not add, "Let *us* go and do likewise."

Oct., 1878.

APPENDIX.

TABLE I.—TABLE SHOWING RELATIVE EXPOSURE OF A COMPANY IN LINE AND COLUMN AT VARIOUS RANGES. (RIFLE MAUSER.)
From Prussian Musketry Instructions 1877.

Sight used	PERCENTAGE OF HITS ON				REMARKS.
	Company in Line Standing.	Company in Column Standing.	Company in Line Lying.	Company in Column Lying.	
Yds.					At the shorter ranges the column does not suffer much more than the line, both standing. At 1,800 yards its loss is double that of the line, while in the lying position at this range, it is three times that of the line, the proportion being less at the shorter ranges.
444	50 to 70	60 to 80	15 to 20	25 to 30	
777	18 to 35	30 to 45	4 to 10	12 to 25	
1555	4 to 10	10 to 14	1 to 3	4 to 8	

TABLE II.—TABLE SHOWING RESULTS OF FIRING AT UNKNOWN RANGES, AT BRÜCH, IN 1875-6. (RIFLE WERNDL.)

Nature of Fire.	Range (Yards.)	Object Fired at.	Hits (per cent.)	REMARKS.
Individual	500	Front of a Company.	26	Distances judged by squads themselves.
	660	128 Figures ..	24	
	830	6 feet high ..	13	
	830	Do. 2 feet high	12	
	500	Company Column	63	
	660		50	
	830		24	
Volley	830	Do. but 3 feet high	26	
Individual	1210	Double Column of Battalions.	67·3	Range approximately known.

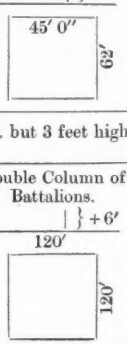


TABLE III.—RESULT OF AUSTRIAN FIELD FIRING IN 1877. (ROUNDS FIRED 674,000.)

From Mittheilungen über Gegenstände des Artillerie und Genie Wesens.

Range (Yards.)	Percentage of Hits.						General percentage of all kinds of Fire.	Remarks.
	Squads.				Company War Strength.			
					Close Order.			
	Volleys (close order.)	Volleys of Groups in open order.	Individual in Open Order.	Individual in Close Order.	Volleys.	Individual.		
660 to 710	..	..	..	..	38	44	40·2	Target—a rectangle representing double column of battalion 120′ × 120′ × 6′.
750 to 800	41	33	34	43	34	29		
920 to 960	34	32	..	34	29			
1,000 to 1,040	33	..	28	34	26	44	32·1	
1,170 to 1,210	30	23	27	26	22	21	24·8	

In the combat firing, advancing from 1,170 to 660 yards and retiring the same distance, the squads made 32 and the companies 30 per cent. of hits on the double column of battalions 120′ × 120′. (Ranges Judged.)

AUSTRIAN FIELD FIRING AT RATTSDORF, 1877.

2 Battalions (743 men), advanced from 1170 to 250 yards from the targets in 1 hour, 25 minutes. An average of 36 rounds was found sufficient. Total, 22,000 rounds fired.

The targets were 500 feet (in detached lengths) of skirmishers 2 feet high.
3 groups of supports, each 62 feet, and 3 feet high.
3 „ reserves „ 55 „ 5 feet 6 inches high and less.

The skirmishers were much hid by trees, the reserves only appeared for, from 5 to 10 seconds, in 2 or 3 minutes, and were then hid.

Hits made were.—On shooting-line 221; supports 1196; reserves 163, or 7·2 per cent.

Some squads, in dominant portions, fired over the heads of the advancing troops without inconvenience. None of the ranges were known.

BERDAN RIFLE.

With the Berdan, 49 per cent. of hits at 1166 yards, with picked shots, and 18 per cent. with recruits fresh from a march, have been made this year on targets screened by a 7 feet parapet.

Against a battalion column target 90 feet × 90 feet, 8 per cent. of hits were made this year at 3,100 yards (known) range. (Tchebitchew's Report.)

MARTINI-HENRY RIFLE.

With the Martini-Henry, a rectangle of 100 feet long by 45 feet, has been found to catch 33 per cent. of shots at 2,000, and 65 per cent. at 1,500 yards.

TABLE IV.—SEARCHING POWER OF MODERN SMALL ARMS.

RANGE.	DROP ONE IN.				GRAS RIFLE.	
Yards.	Martini.	Mauser.	Berdan.	Gras.	Time of Flight. Seconds.	Velocity at each Range. Ft. per second.
0	0	0	0	0	0	1476
200	85	..	..	130	½″	1120
300	60	..	61	85		
400	50	..	44	64	1	915
500	40	35	38	43		
600	30	30	..	32	1·75″	800
700	25	23	..	24		
800	20	19	..	20	2·5″	700
900	17	16	..	16		
1000	14	13	..	13	3·75″	625
1100	..	11	..	11		
1200	..	9·25	..	9·25	4·5″	558
1300	..	8·5	..	8		
1400	..	7·5	..	6·75	5·5″	506
1500	..	6·25	..	6		
1600	..	5·75	..	5·25	7″	456
1700	..	5·25	..	4·75		
1800	..	4·75	..	4	8·25″	436
1900	..	..	..	3·5		
2000	4	3·85	*	3·25	10″	412
Sighted to	1400 yds.	1750 yds.	1200 yds.	1960 yds.	Observed.	

* As stated by General Tchebitchew in a report of 1878, given by the "Invalide Russe." Translated in the "Revue de l'Etranger, 24/8/78."

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DIAGRAM.

To shew the relative areas affected by Musketry and Artillery Fire in the past & present.

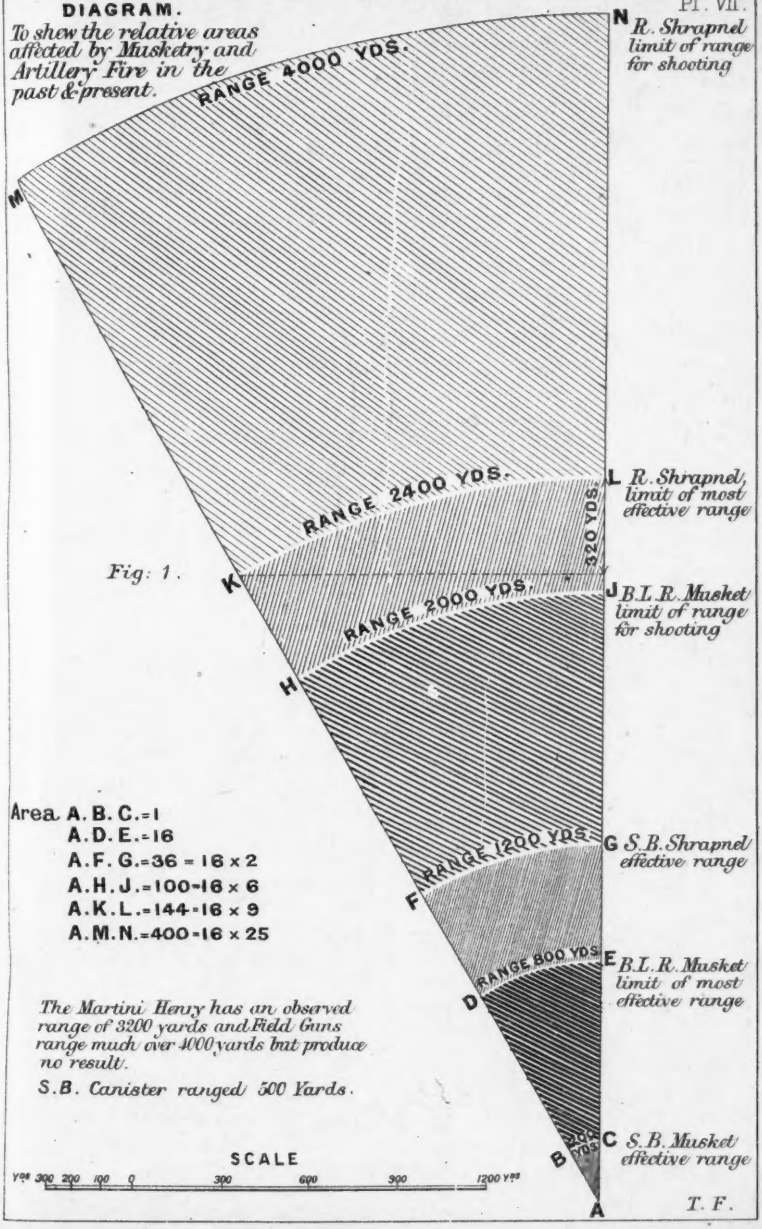


Fig: 1.

Area A. B. C. = 1
A. D. E. = 16
A. F. G. = 36 = 16 × 2
A. H. J. = 100 = 16 × 6
A. K. L. = 144 = 16 × 9
A. M. N. = 400 = 16 × 25

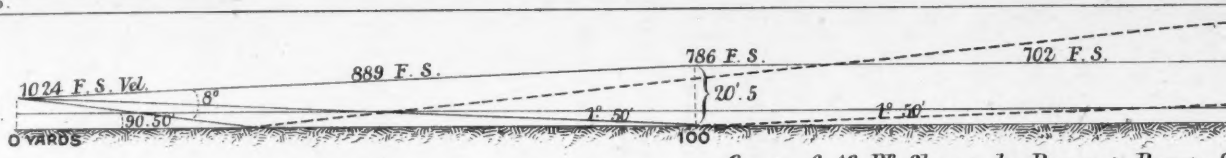
The Martini Henry has an observed range of 3200 yards and Field Guns range much over 4000 yards but produce no result.

S.B. Canister ranged 500 Yards.

T. F.

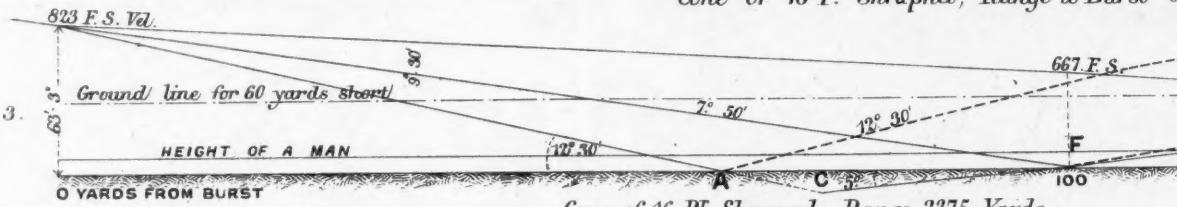
Thos Kell Lithographer
40, King St. Covent Garden

Fig: 2.



Cone of 16 Pr Shrapnel, Range to Burst 9

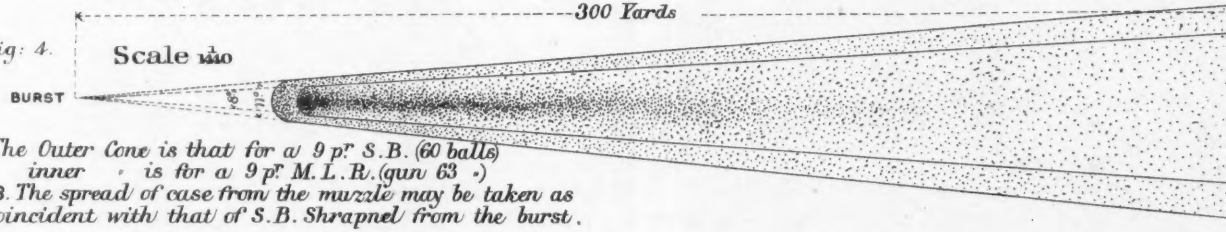
Fig: 3.



Cone of 16 Pr Shrapnel, Range 2375 Yards.
The line C.F.D. shows the diminution of sweep due to

Comparative spread of S.B. & Rifled Shrapnel
Range 900 Yards to the burst.

Fig: 4.



The Outer Cone is that for a 9 pr S.B. (60 balls)
" inner " is for a 9 pr M.L.R. (gun 63 ")
N.B. The spread of case from the muzzle may be taken as coincident with that of S.B. Shrapnel from the burst.

Diagram, shewing the amount of cover for each foot of parapet against fire at various ranges.

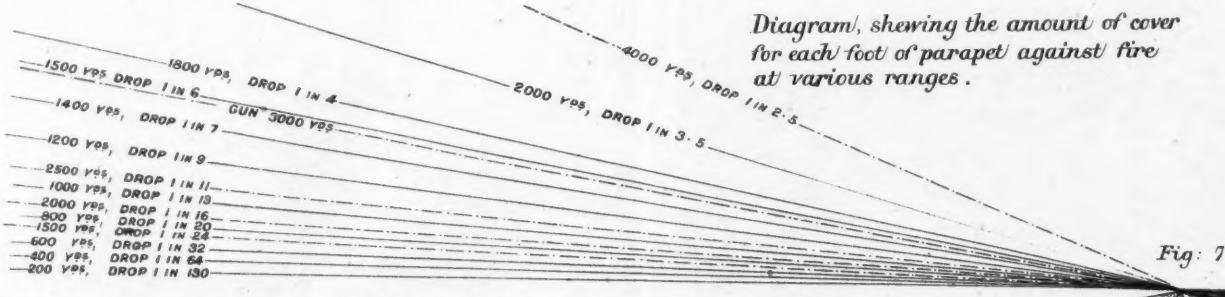
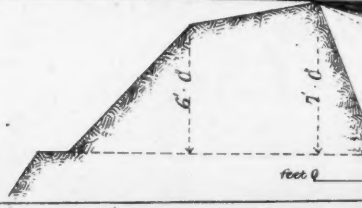
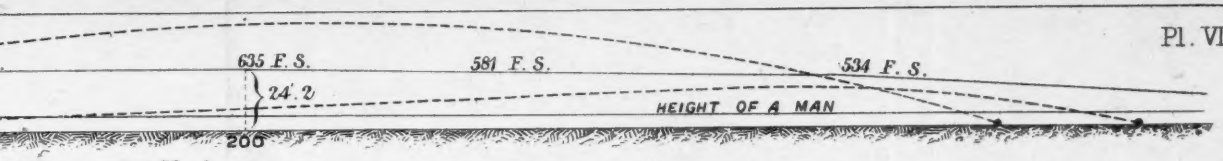

1500 YDS DROP 1 IN 6
1800 YDS, DROP 1 IN 4
4000 YDS, DROP 1 IN 2.5
GUN
3000 YDS
2000 YDS, DROP 1 IN 3.5
1400 YDS, DROP 1 IN 7
1200 YDS, DROP 1 IN 9
2500 YDS, DROP 1 IN 11
1000 YDS, DROP 1 IN 13
2000 YDS, DROP 1 IN 16
800 YDS, DROP 1 IN 20
1500 YDS, DROP 1 IN 24
600 YDS, DROP 1 IN 32
400 YDS, DROP 1 IN 64
200 YDS, DROP 1 IN 130

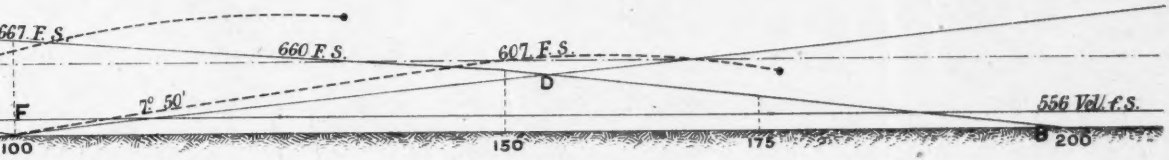
Fig: 7

NOTE. The ___ lines of fire shew the drop with a B.L.R. field Gun
The ——— " " those with the Gras B.L.R. small arm
The ----- " are the lower limits of the cone of Shrapnel for
of the ___ lines.

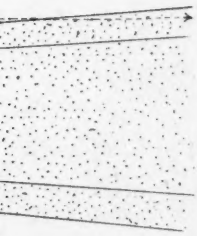




to Burst 900 Yards.



eep due to 5° depression



of cover
fire

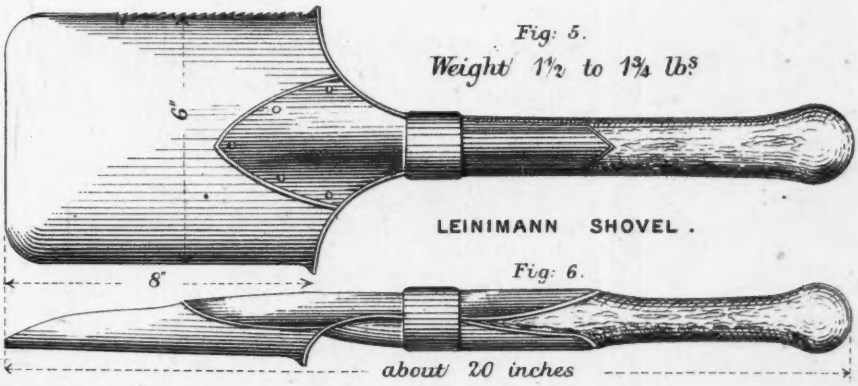


Fig: 5.
Weight 1½ to 1¾ lbs

LEINIMANN SHOVEL.

Fig: 6.

about 20 inches

Diagram of the elevation and drop of M.H. bullets at extreme ranges.

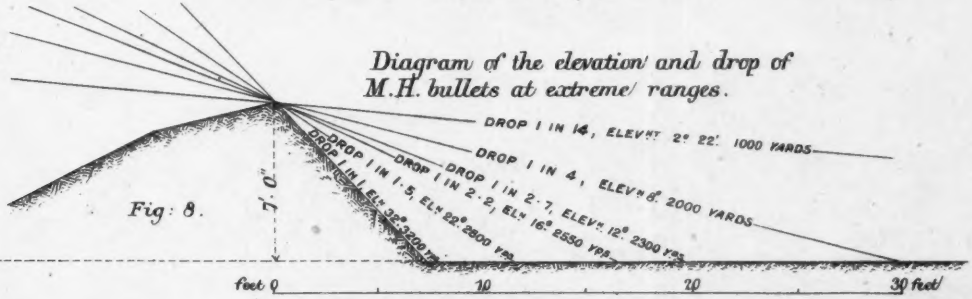
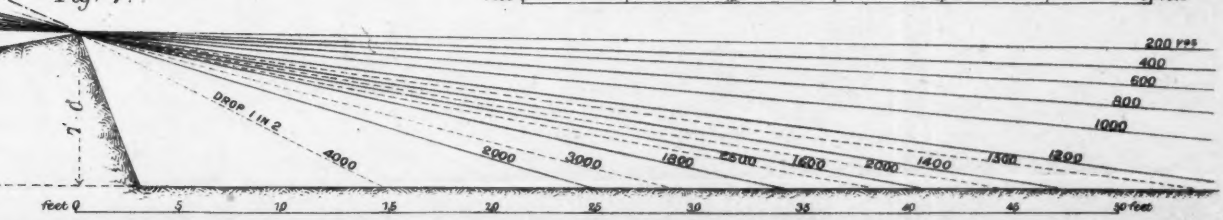

DROP 1 IN 14, ELEVN 2° 22' 1000 YARDS
DROP 1 IN 4, ELEVN 6° 2000 YARDS
DROP 1 IN 2·7, ELEVN 12° 2300 YDS
DROP 1 IN 2·2, ELN 16° 2550 YDS
DROP 1 IN 1·5, ELN 22° 2800 YDS
7'.0"
feet 0
10
20
30 feet

Fig: 8.

Fig: 7.



T.F.

RICOCHET.

The ricochet appears from observation to be greater than the drop in the ratio of about 9 to 5, and has been so drawn.

Results got with 1400 m. sight

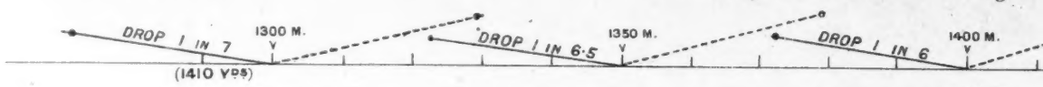
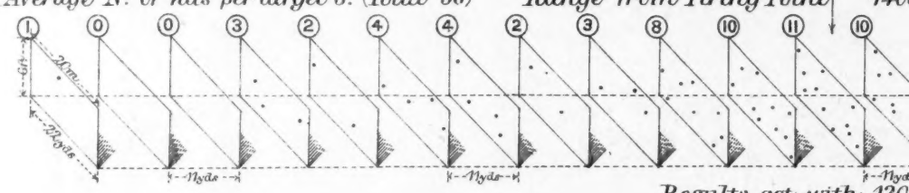


Fig. 9.

Average N° of hits per target 5. (Total 96) *Range from Firing Point* *140*

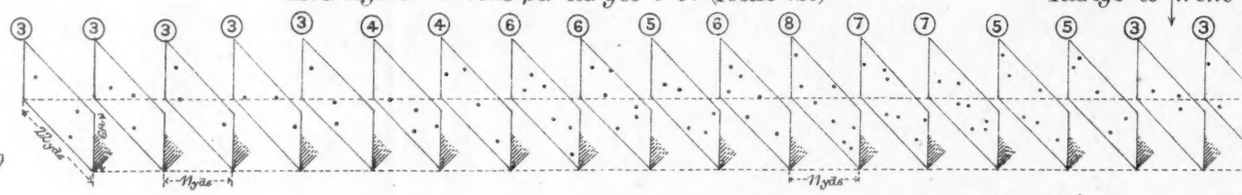


Unders 43

Results got with 130

Fig. 10.

Average N° of hits per target 3·3. (Total 126) *Range to from*



Unders 80

The same as Fig. 2 but we

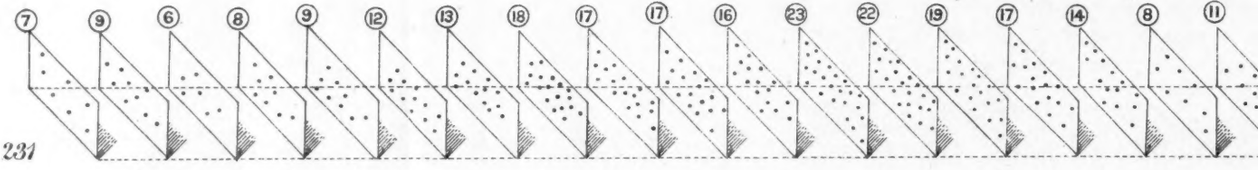


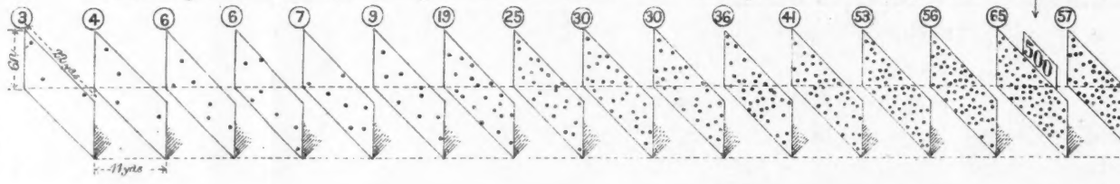
Fig. 11.

Unders 231

Results got with 500 m.

Average N° of hits per target 20. (Total 726) *Range from Firing Point to 500 m.*

Fig. 12.



Unders 390

Results got with 500 and 600 m. s

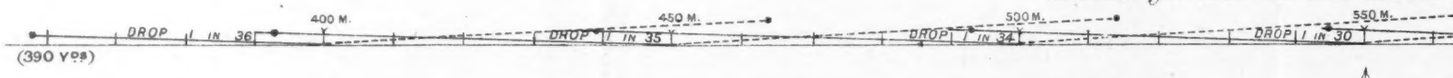
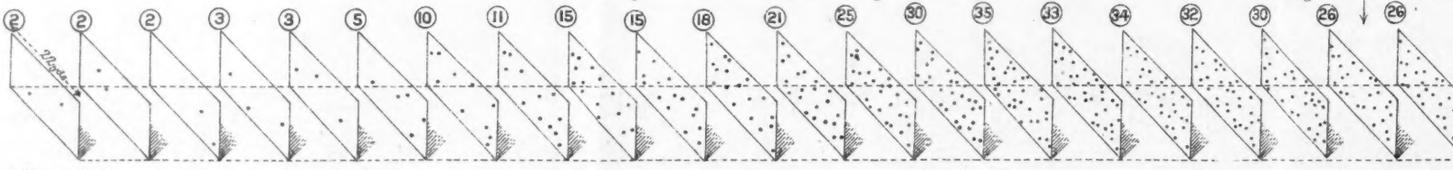


Fig. 13.

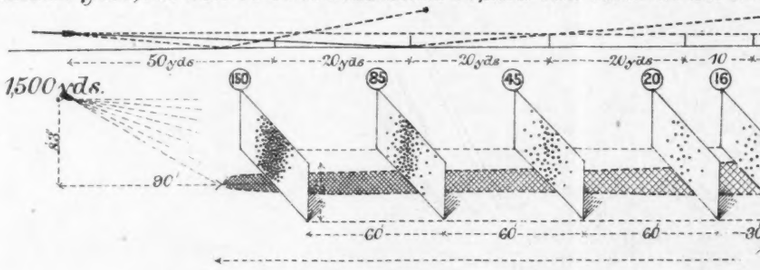
Average N° of hits per target 16. (Total 655) *Range to from F*



Unders 339

Diagram shewing the effect, including ricochets, of a round of shrapnel from a rifl
those with the 9 pr. M.L.R. field gun). It will be seen that about 60 p.c. of hits occur on the fir

Fig. 14.



Range to burst, 1,500 yds.

At ranges from 400 to 1400. M. the unders to overs are as 23 to 19 with one sight, and as 17 to 15 with two.

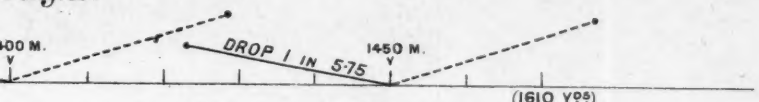
DIAGRAMS

9, 10, 12 and 13, shew the way in which a space, having a height of a man, and a front of 50 men is affected by a salvo of 100 rounds of Mauser ammunition fired from the lying position, rifles rested.

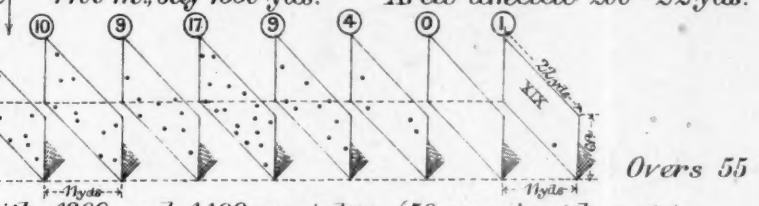
N.B. Results are exclusive of ricochets.
The targets used were paper.
Nº of hits on each target shewn thus ⑩
The vertical height of the targets is exaggerated fourfold.

With 800 and 900. M. sights 100 rounds gave 234 hits on 38 } Targets
" 900 " 1000 M " " " " 201 " " 34 } as in
" " " 900 M " " " " 235 " " 25 } diagrams

. sight.

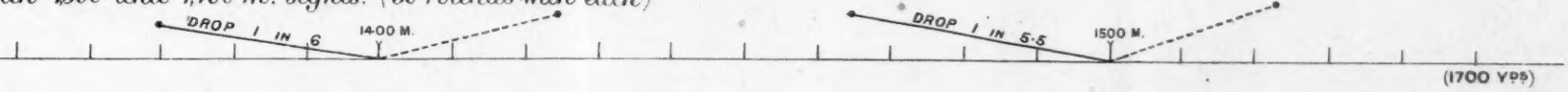


1400 m., say 1530 yds. Area affected 200 × 22 yds.

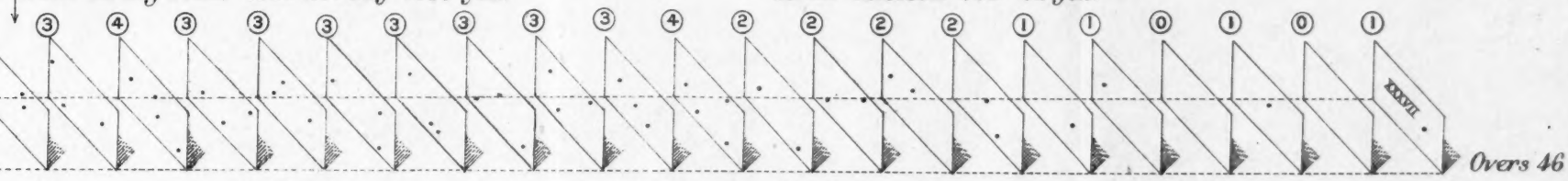


Overs 55

ith 1300 and 1400 m. sights. (50 rounds with each)

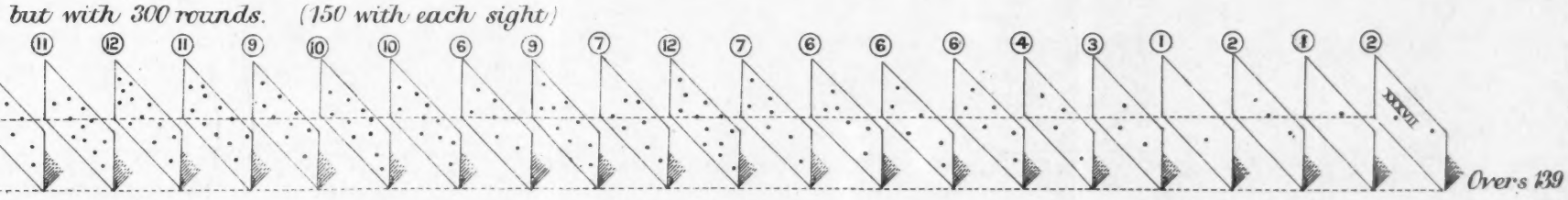


from Firing Point 1350 m. say 1480 yds. Area affected 400 × 22 yds.



Overs 46

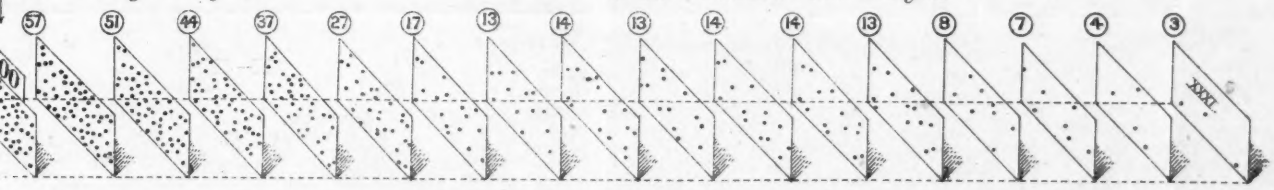
but with 300 rounds. (150 with each sight)



Overs 139

500 m. sight.

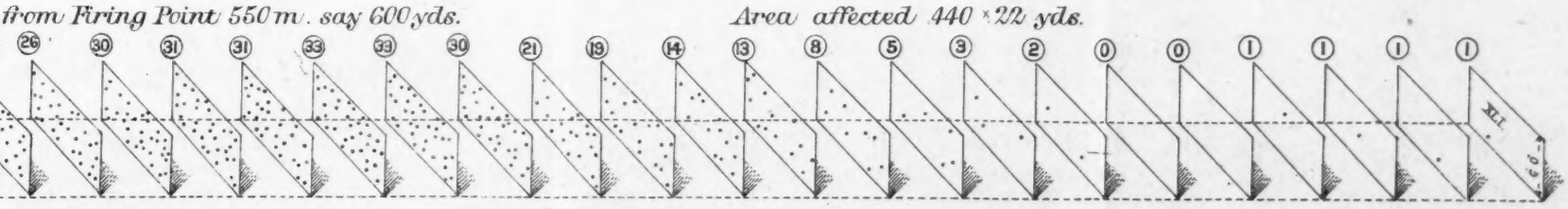
500 m. say 550 yds. Area affected 330 × 22 yds.



Overs 336

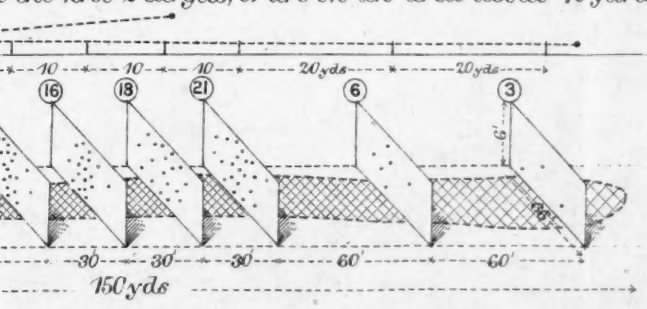
600 m. sights. (50 rounds with each)

from Firing Point 550 m. say 600 yds. Area affected 440 × 22 yds.



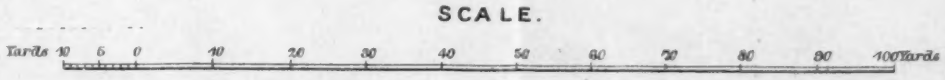
Overs 316

a rifled gun of position. The possible direct hits are 180, (about twice the first 2 targets, or are on an area about 40 yards long by 5 yards wide.



The angle of dispersion of the cone containing 75 p.c. is about 6°.
The remainder scatters widely.

SCALE.



T. F.

Thos Kell Lithographer
40 Kenf St Covent Garden

PIVOT STAND WITH BRACKET (B) AND CLAMP (A)

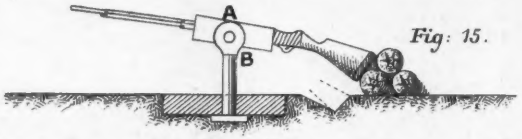


Fig: 15.

The clamp to be somewhat like the Palmcrantz frame, at night a quadrant at A could be used for aiming: recoil taken by a plank and sandbags: trigger rod and lanyard for firing.

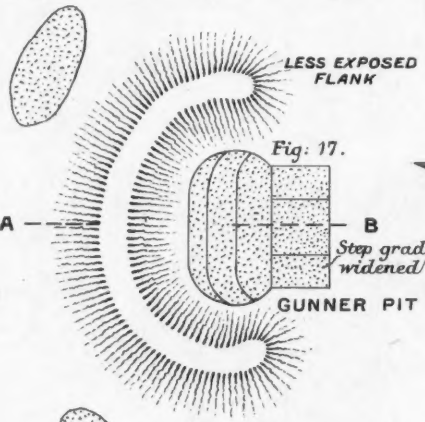


Fig: 17.

Scale $\frac{1}{96}$ TH

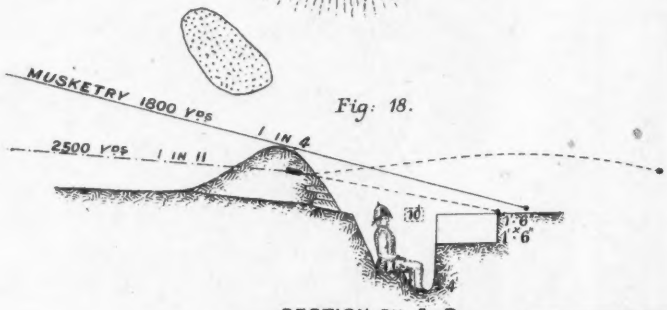


Fig: 18.

SECTION ON A.B.

Fig: 19.

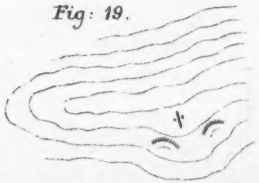


Fig: 20.

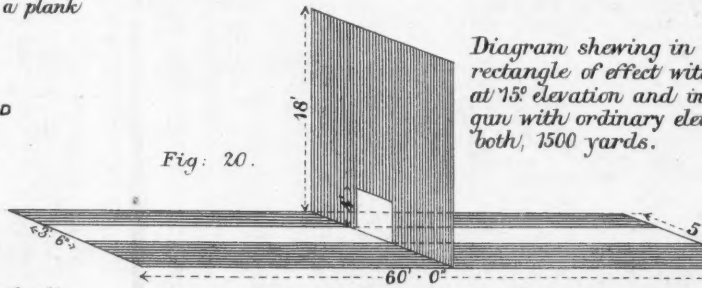


Diagram shewing in rectangle of effect wit at 15° elevation and in gun with ordinary ele both, 1500 yards.

Fig: 22.

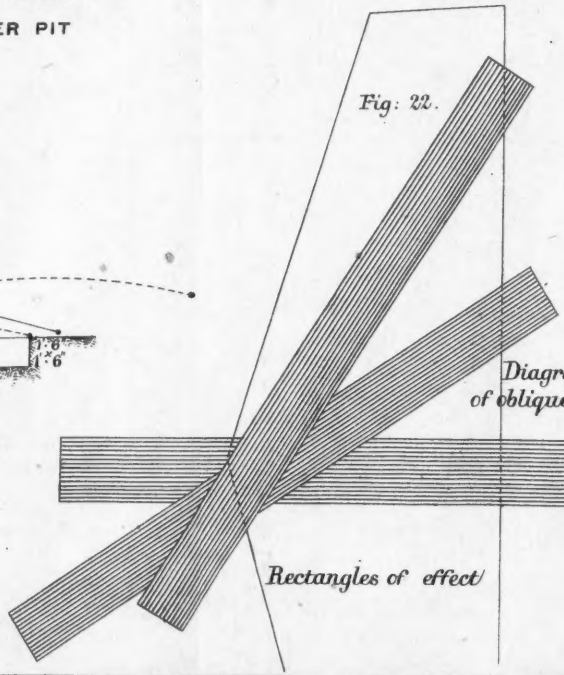
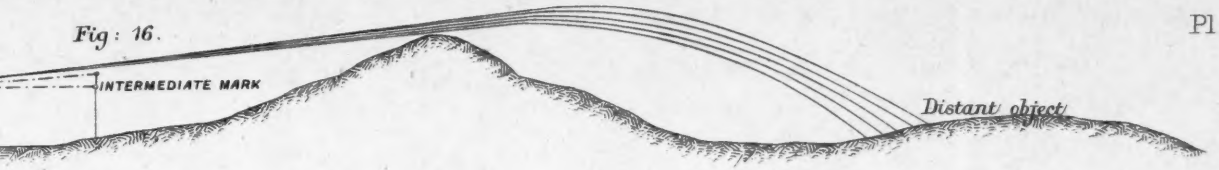


Diagram shewing advan of oblique artillery fire aga

Rectangles of effect

GUN FIRE
MUS

Fig: 16.



shewing in black the
of effect with a howitzer
tion and in side that of a
ordinary elevation, range for
yards.

In each case the dimensions of the rectangles are those which will catch 25 p.c. of the rounds fired.
The total dispersion is 4 times the mean.

Fig: 21.

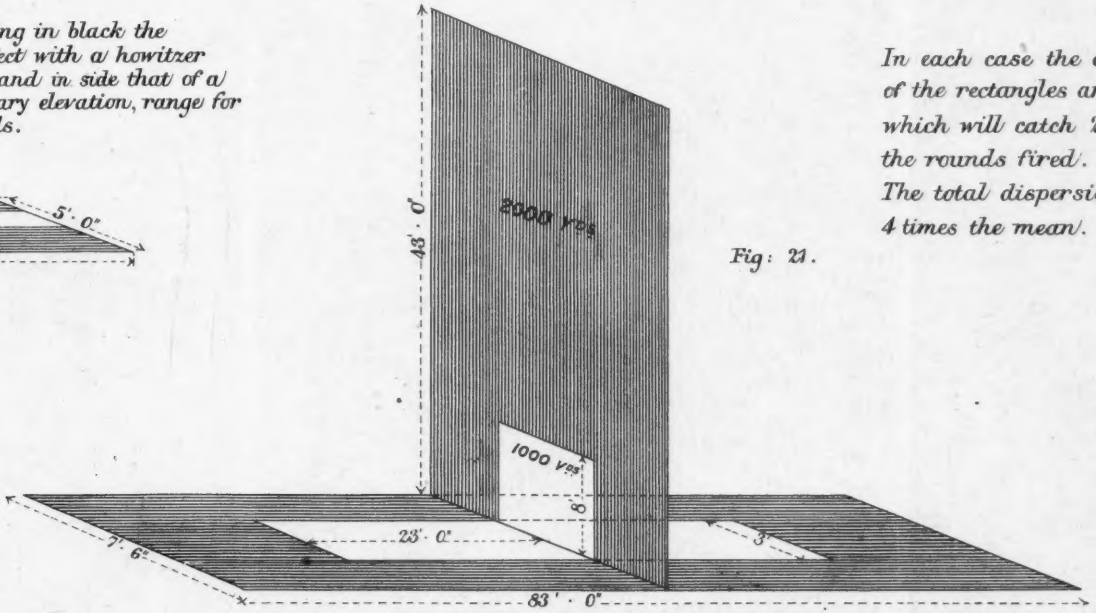
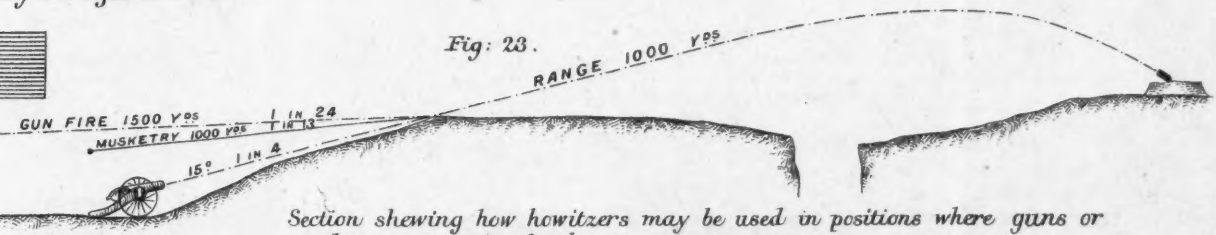


Diagram shewing the relative rectangles of a howitzer at 1000 and 2000 Yards range, with the same charge.

ewing advantage
ery fire against works.

Fig: 23.



Section shewing how howitzers may be used in positions where guns or musketry cannot touch them.

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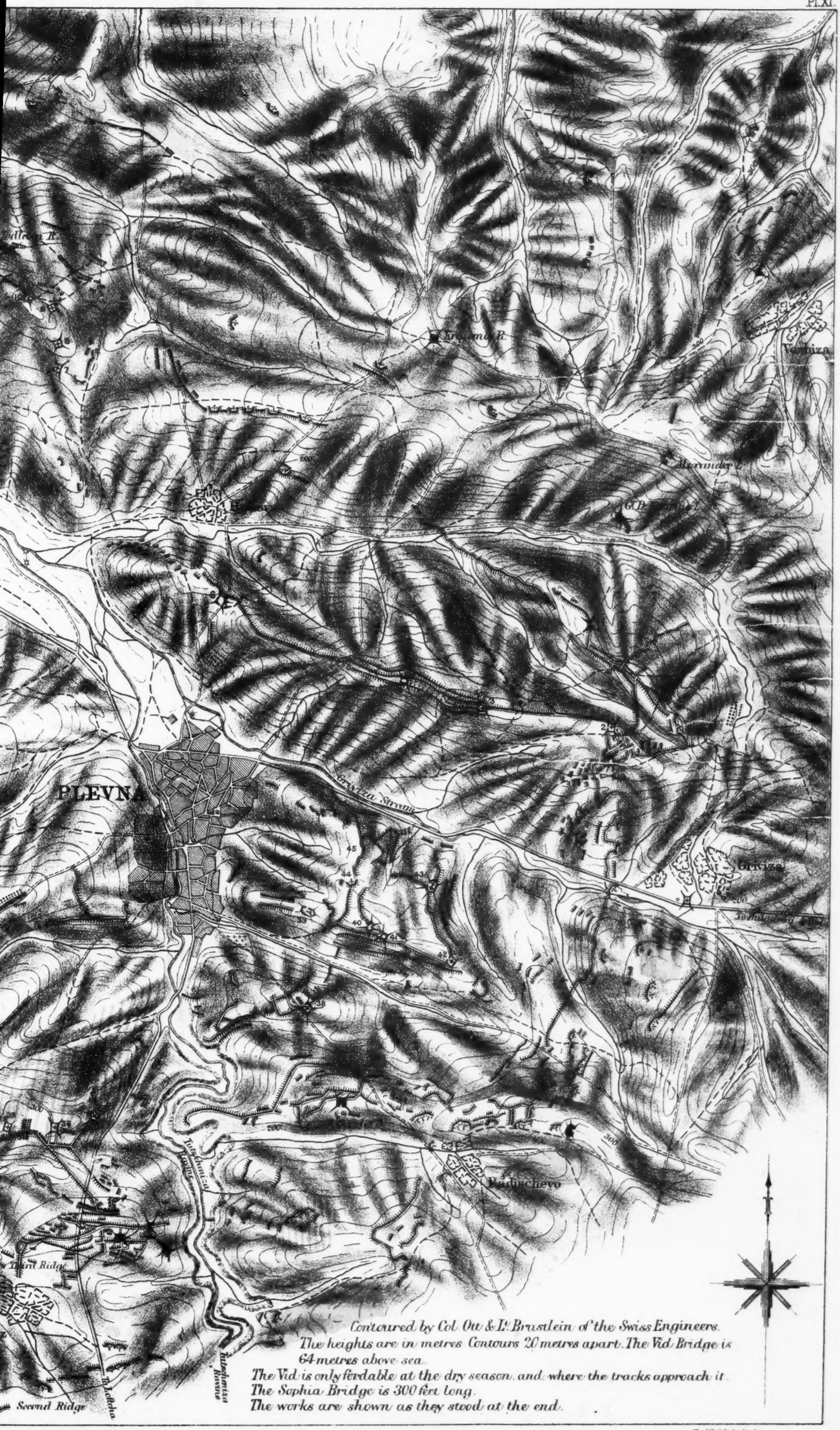
Vol 23.

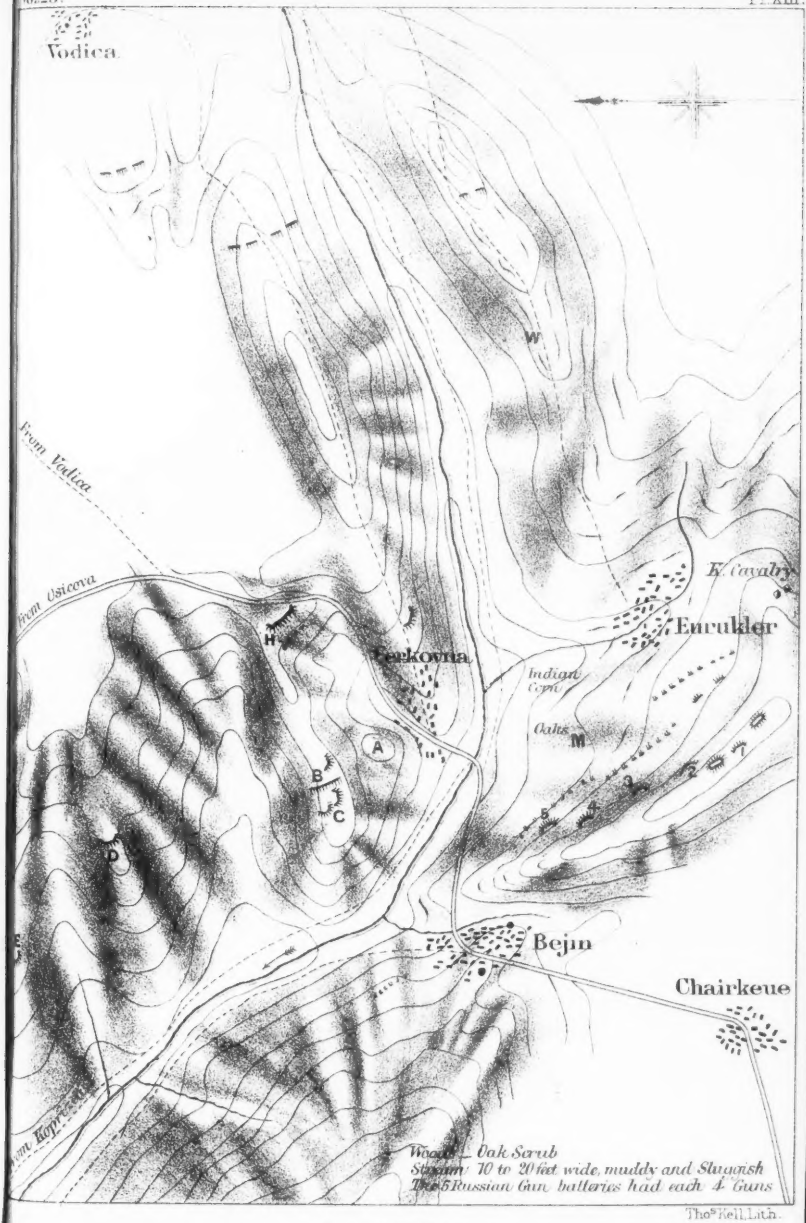

PLEVNA
Grivitza Strouni
Grivitza
Radischevo
Vantiza
Mazmundja R.
Mazmundja
Tsarevetz Hill
Tsarevetz Redoubt
Grivitza Redoubt
Third Ridge
Second Ridge
To Lovtcha
To Sofia
Contoured by Col. Ott & Lt. Brustlein of the Swiss Engineers.
The heights are in metres. Contours 20 metres apart. The Vid Bridge is 64 metres above sea.
The Vid is only ferdable at the dry season, and where the tracks approach it.
The Sophia Bridge is 300 feet long.
The works are shown as they stood at the end.

Tho.s Kell. Lithographer
40 King S.t Covent Garden

ATTACK OF LOVTCHA.—SEPR 1877.

Pl. XII.

ACTION NEAR CHAIRKEUE.



Thos Kell Lith.

Scale (1 85292)

Yards 1000 500 0 1000 2000 3000 4000 5000 6000 7000 8000 Yards

TURN
Fordw
Fiver
Burdi

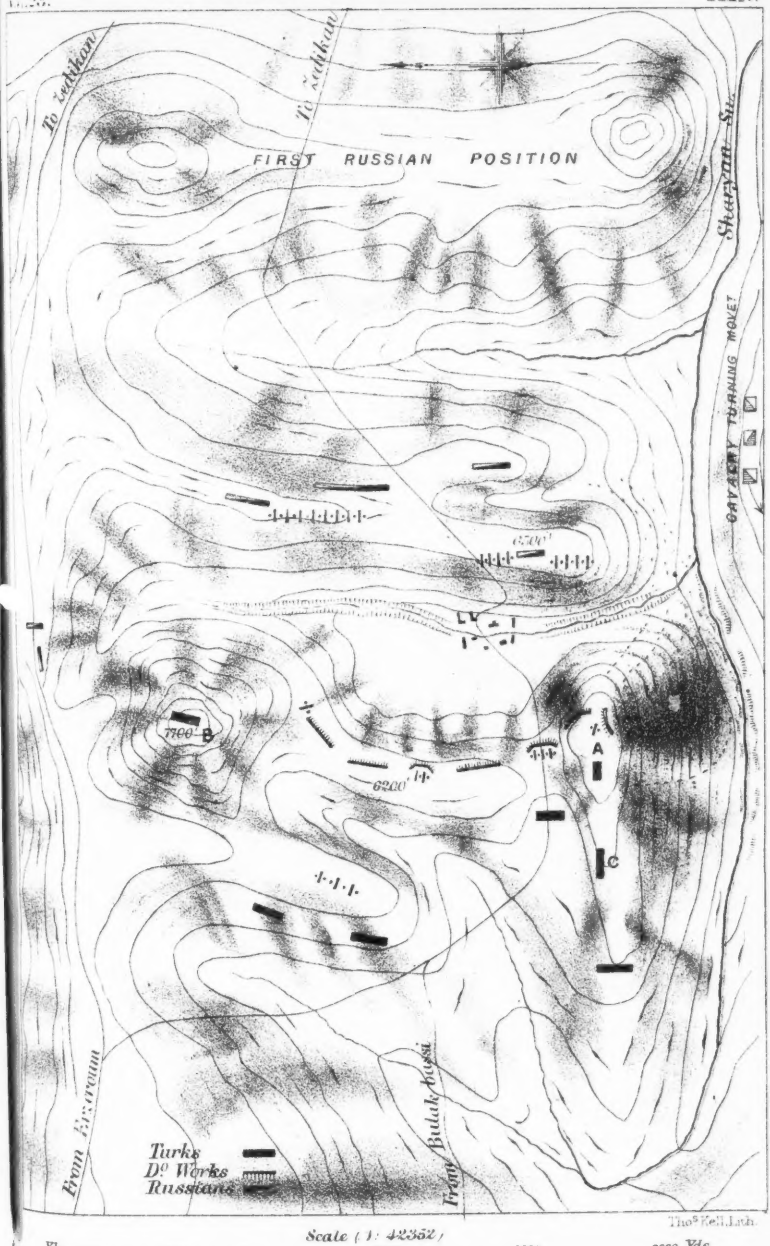
BATTLE OF ZEVIN.—JUNE 25TH 1877.

Thos Kell Lith.

Journal RUSI Vol. XX.

BATTLE OF TAGHIER.

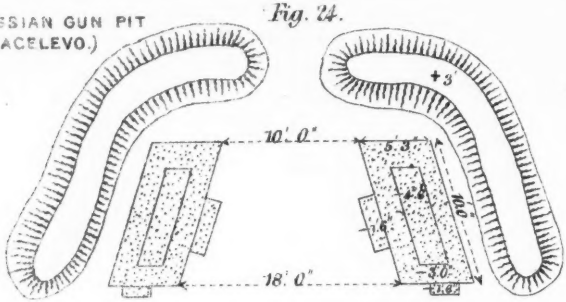
Pl. XV.



CONCLUSIO

RUSSIAN GUN PIT
(KACELEVO.)

Fig. 24.



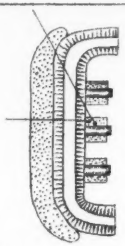


Fig. 28.

Sho

FIG. 25.

Line

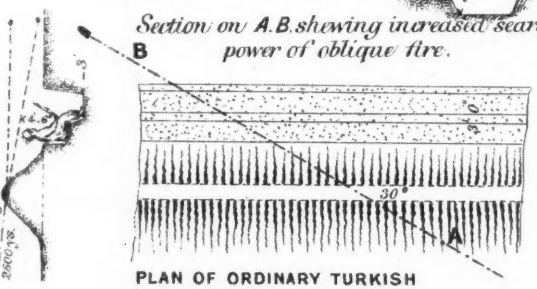
Fig. 29.

Section on A.B. shewing increased searching power of oblique fire.

Secon

40

Thi



PLAN OF ORDINARY TURKISH
SHELTER TRENCH

ROOFED SHELT

TURKISH GUN EPAULMENT
(RASGRAD.)

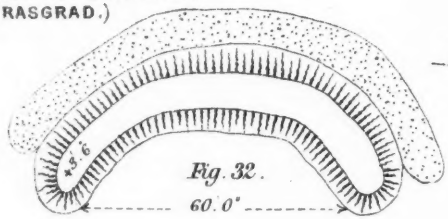
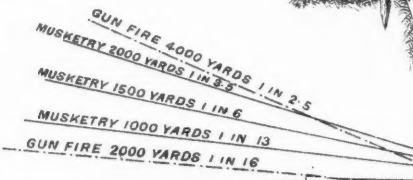
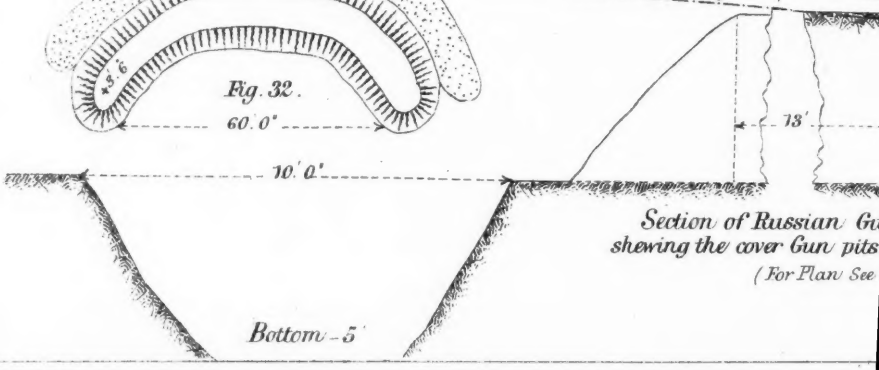


Fig. 32.


GUN FIRE 4000 YARDS 1 IN 2.5
MUSKETRY 2000 YARDS 1 IN 3.5
MUSKETRY 1500 YARDS 1 IN 6
MUSKETRY 1000 YARDS 1 IN 13
GUN FIRE 2000 YARDS 1 IN 16



Section of Russian Gu
shewing the cover Gun pits
(For Plan See

CONCLUSION FROM 1870-71.

Shooting line.

FIG. 25. 300 yds.

Line or Columns

500 yds.

Columns 1500 yds.

300 yds.

Second Line

400 to 500 yds.

Third Line

RUSSIAN 1877.

Chain

FIG. 26. 250 yds.

Line or Columns

300 yds 950 yds.

Second Line

400 yds.

Main Reserve.

RUSSIAN CONCLUSION FROM 1877.

Grouped Chain

FIG. 27. 200 yds.

Columns of Sections

300 yds.

Company Sections

300 yds. 1200 yds.

Second Line

400 yds.

Main Reserve.

FORMATIONS FOR ATTACK.

OOFED SHELTER TRENCH, KARRAHASSAN KEUE.

Fig. 30.

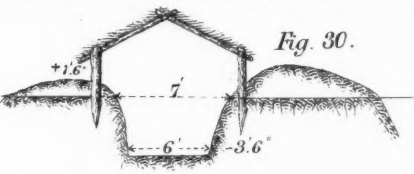
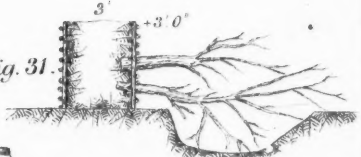


Fig. 31.



TURKISH HURDLE WALL AT SARNARSUFLAR.

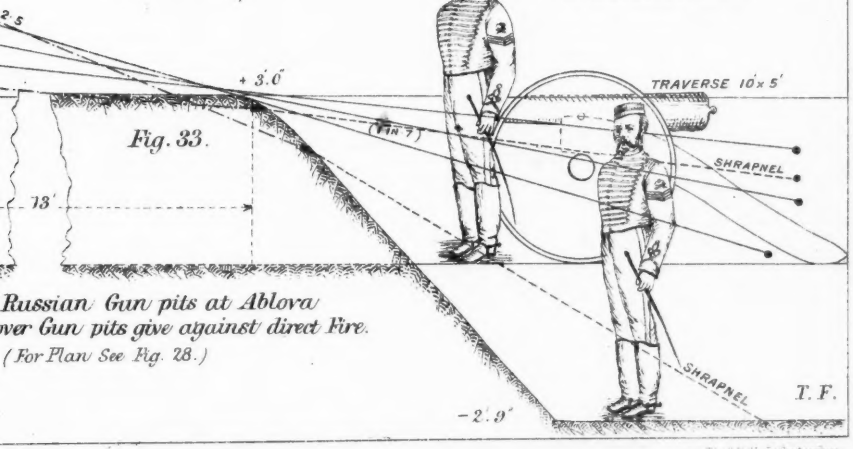


Fig. 33.

Russian Gun pits at Ablova
wer Gun pits give against direct Fire.
(For Plan See Fig. 28.)

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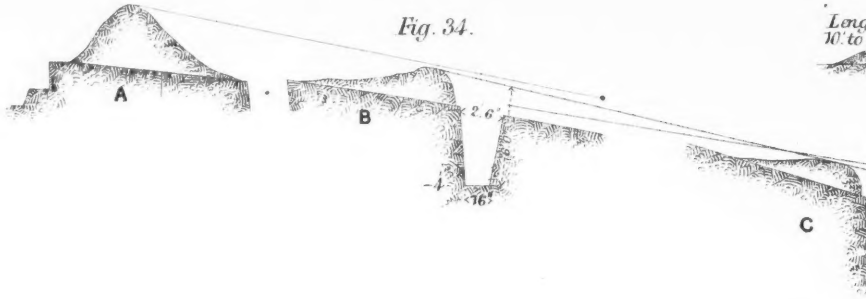
Thos. Kell, Lithographer
4a King St. Covent Garden

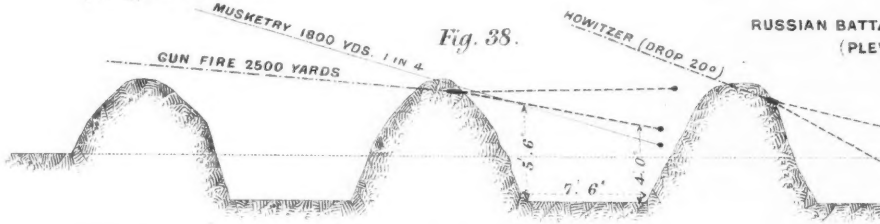
Fig. 34.



USE OF RAISED SIGHTS.

Fig. 36.

Fig. 38.



RUSSIAN BATTA
(PLE

INTRENCHED CAMPS — CHANGE IN EXTENT OF ATTACK AND DEFENCE

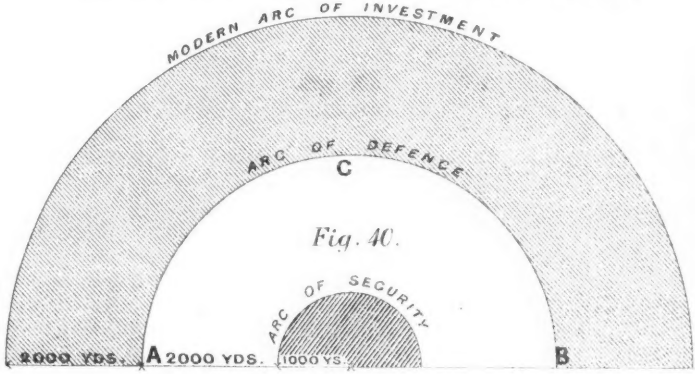
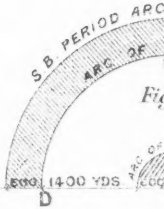


Fig. 40.

Area A. C.
D. E.
Modern arc
Former do
Modern arc
Former do



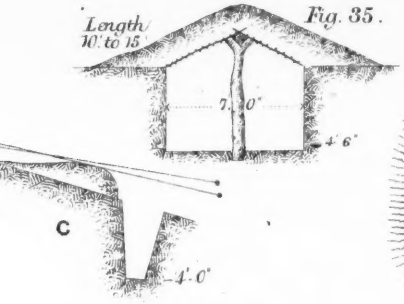
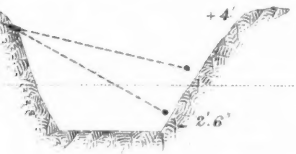


Fig. 35.

RUSSIAN BATTALION SHELTER
(PLEVNA.)



rea A.C.B. 9
D.E.F. 4

Modern arc of attack = 5
Former do. do. = 3·5
Modern arc of defence = 3
Former do. do. = 2

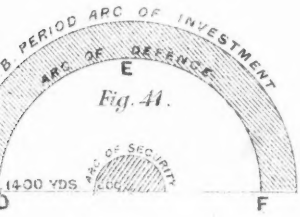


Fig. 41.

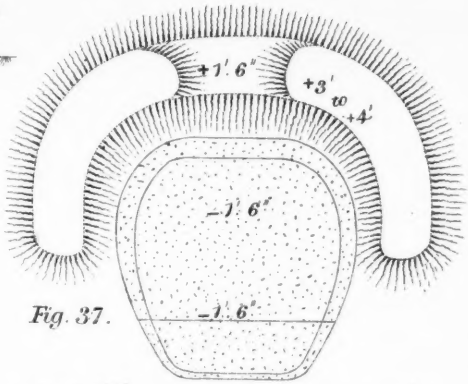


Fig. 37.

Fig. 39.
EGYPTIAN
SHELTER TRENCH
(1877.)

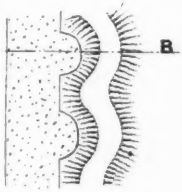
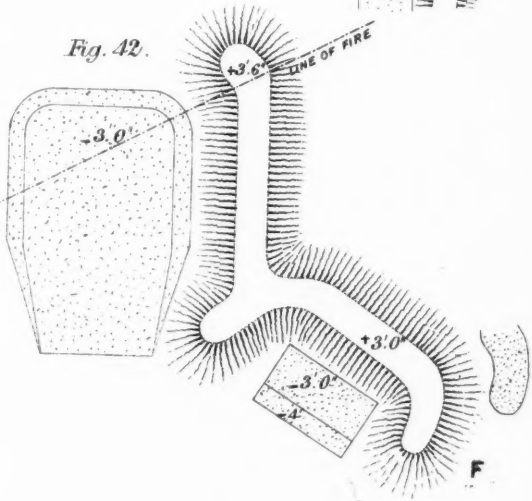


Fig. 42.



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Thos Kell, Lithographer.
4to. King St. Covent Garden

Fig: 43.

Fig: 45.

Fig: 43.

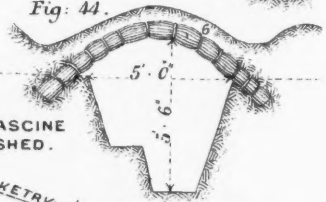


Fig: 44.

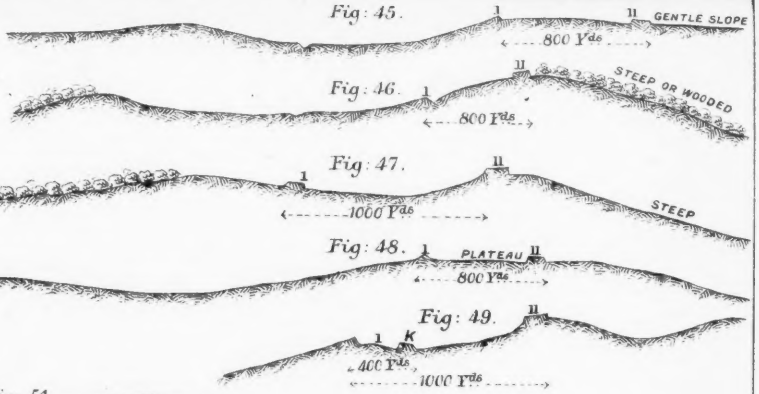


Fig: 45.

Fig: 46.

Fig: 47.

Fig: 48.

Fig: 49.

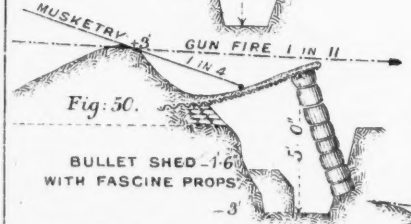


Fig: 50.

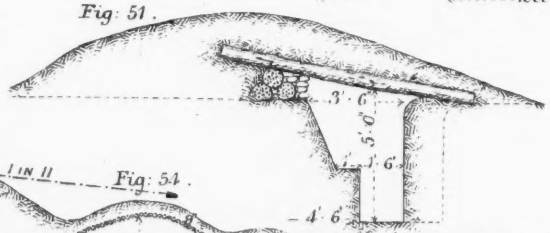


Fig: 51.

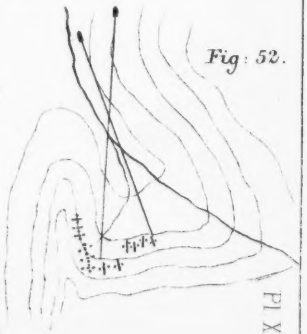


Fig: 52.

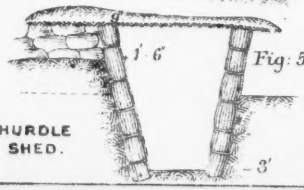


Fig: 53.

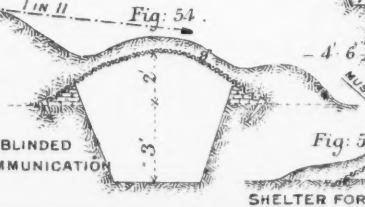


Fig: 54.

Fig: 55.

Fig. 56.

METHOD OF FIXING THE POSITION OF SHELTER TRENCHES &c.

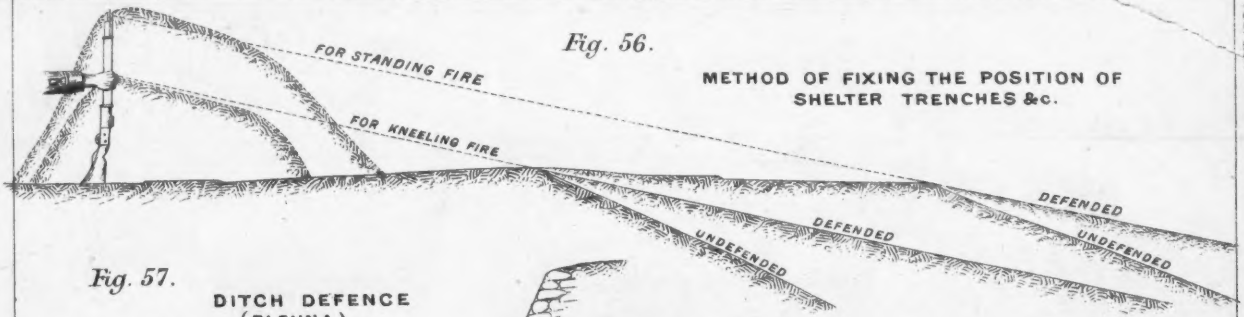
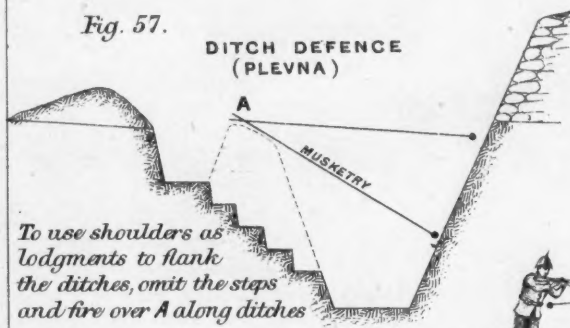


Fig. 57.

DITCH DEFENCE (PLEVNA)



To use shoulders as lodgments to flank the ditches, omit the steps and fire over A along ditches

Fig. 58.

SHELTER FOR RESERVES.

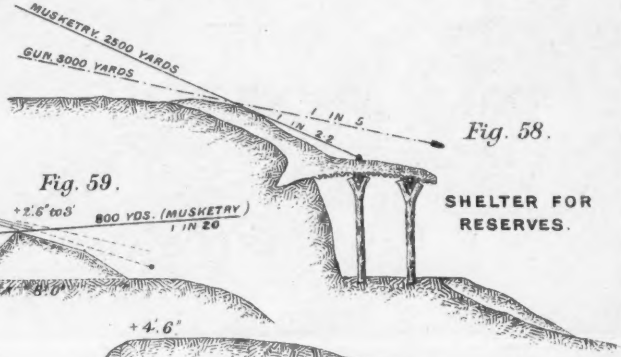
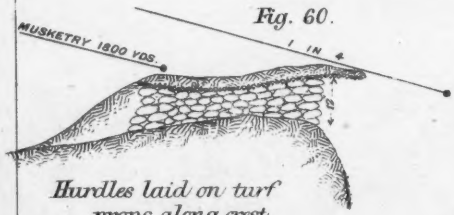


Fig. 59.

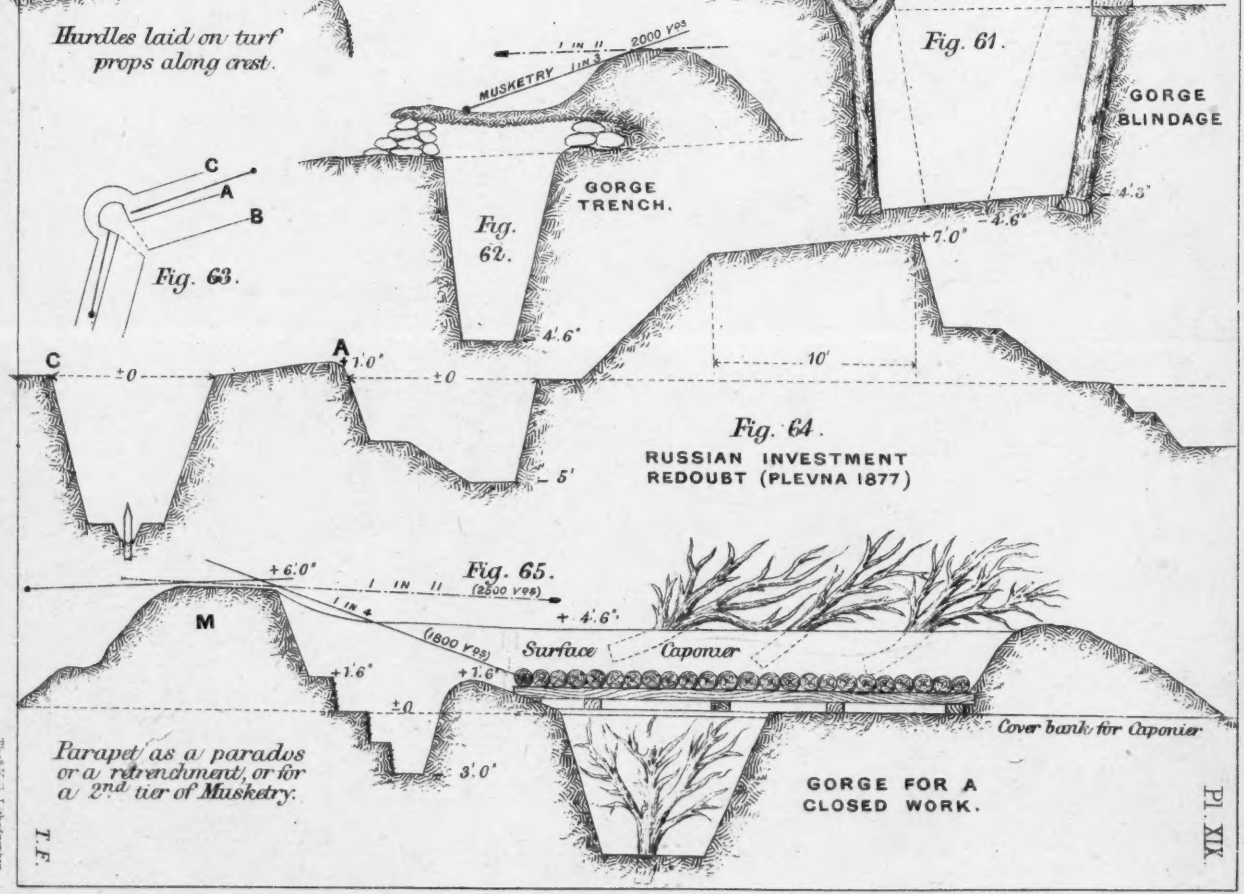
Fig. 60.



Hurdles laid on turf props along crest.

Fig. 61.

GORGE BLINDAGE

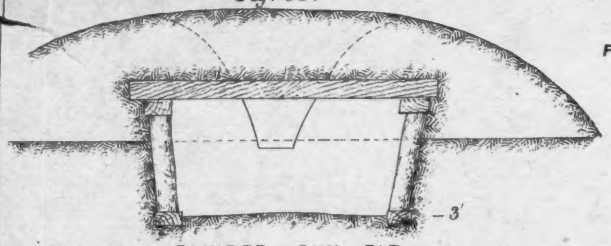


Thos. Ford Lithographer 40 King St. Covent Garden

Front

Fig: 66.

Fig: 66.



BLINDED GUN-PIT

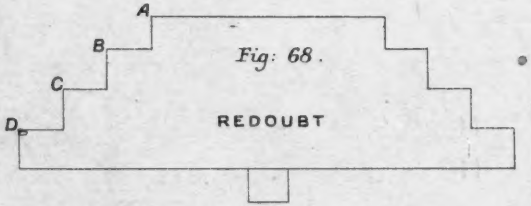


Fig: 68.

REDOUBT

FLANK OF REDOUBT

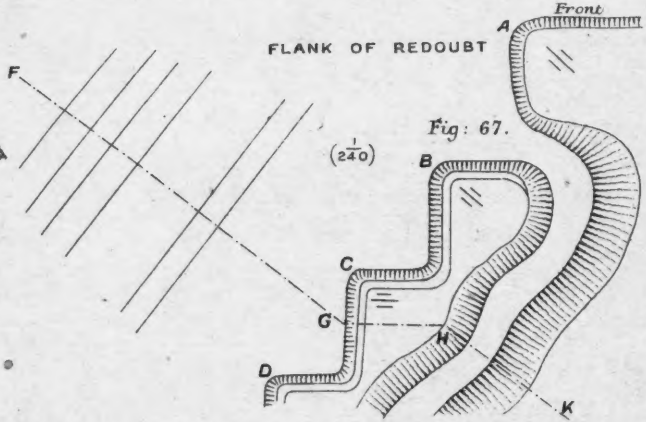


Fig: 67. $(\frac{1}{240})$

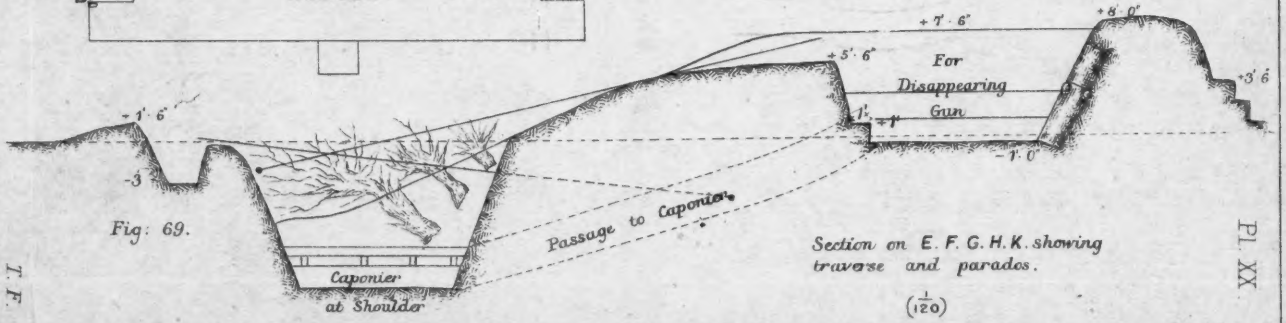


Fig: 69.

Section on E. F. G. H. K. showing traverse and parados.

$(\frac{1}{120})$

T. F.

Pl. XX.

TABLE V.

Comparative Table of the Principal European Small Arms.

Name.	Calibre.	Weight of Bullet	Weight of Charge.	Initial Velocity.	Velocity at 1,000 yards.	Angle of Drop at 1,000 yards.	Weight of 100 rounds.	Approximate Recoil.	Ammunition per man. (Carried Regimentally.)		Remarks.
		(grs.)	(grs.)				lbs. oz.	lbs.		Rounds.	
Martini Henry (England)	0·450	480*	85	1353†	702†	4° 5′	10 15	95	Men	70	Boxer cartridge case.
									Carts ..	30	
Martini Henry (Turkey)	0·450	480	80	1380	730	4°	10 5	..	Men	100	A solid cartridge case said to give 40 feet higher velocity.
									Horses ..	100	
Mauser (Germany)	0·435	385	77	1470†	685†	4° 9′	7 13	80	Men	80	The German total is 4,500,000 rounds per Army Corps.
									Wagons ..	37	
Gras (French)	0·433	385	81	1476†	694	4° 6′	9 11	85	Men	74	
									Wagons ..	18	
Berdan (Russian)	0·421	370	79	1380†	688†	4° 24′	8 9	72	Men	84	Proposed by Gen. Zeddeler. Men .. 105 Horses .. 25 Carts .. 70
									Wagons ..	35	
Werndl (Austria)	0·421	370	74	1430	612	4° 41′	7 3	77	Men	60	
									Carts (3 horse)	70	

* With the carbine bullet (410 grains) the drop is less up to 600 yards, and beyond that greater than with the 480 grain bullet.
† Observed.

LECTURE.

Friday, March 14, 1879.

GENERAL SIR WILLIAM CODRINGTON, G.C.B., &c., &c., Vice-President, in the Chair.

ON THE RESULTS OF FIELD FIRING IN INDIA IN VIEW TO THEIR TACTICAL APPLICATION.

By Lieutenant-General the Honourable ARTHUR E. HARDINGE, C.B.

THE character of this audience will be my guarantee, that in any views I venture to submit, none will be advanced in any spirit of pretension. On the contrary, I am too well aware that the subject which I have undertaken to introduce to you—and only to introduce to you, for it is one of a long range—is, I will not say familiarly an "old "friend with a new face," but I would rather say diffidently, an "old "problem under fresh difficulties," difficulties that are, in some measure, speculative in their nature, difficulties that are not free from some delicate susceptibilities, difficulties which, whenever discussed, are likely to re-open controversies that, long and warmly waged, still remain unsettled. These reflections might well deter me from this undertaking. On the other hand I considered that Indian experiences might contribute some points of professional interest, and that these might be rendered profitable if an assembly like this would winnow them by their criticisms, enlarge them by their knowledge, and lend their aid to their practical application. There was another reason for this; it was shortly after I was appointed to the command of the Meerut Division, that Lord Napier of Magdala inaugurated that annual field-firing, those practical experiments in field artillery and musketry firing, which I venture to think will not stand last nor least amongst the benefits which he has conferred on the Indian Army. The orders from Simla Head Quarters, upon this head, left great discretionary latitude to the local executive, thereby insuring a great variety of trials.

Lord Napier only insisted upon this, that to give these experiments their fullest scope, the greatest number of troops available should always be employed upon them. Well, Sir, these experiments have now reached their fifth year, they have been carried out—I might quote general orders in support of that assertion—

with unflagging zeal and with constant and striking progress. They culminated at the camp at Delhi, in 1876, with what are known as the Khoolub experiments, when two Divisions of infantry, complete with their artillery, attacked an intrenched position of considerable extent, and they subsequently derived a fresh interest from the issue of the Henry-Martini to the English troops, whilst the Snider remained in the hands of the native army. A very exact comparison between the relative merits of those two arms was thus facilitated. Englishmen, I need not tell you, in every climate and in every country, are fond of handicapping, and the public form of the Martini, taking its mean, over long and short courses, is credited with a superiority of about 7 to 4 over the Snider rifle. This in itself is, I think, a satisfactory result. I think we may conclude from it that the English army has probably the best weapon in the world, if it will learn in peace how best to use it in time of war. These Indian experiments have, as I said, now reached their fifth year; and unless the Generals, charged with their directions, who have had the advantage of constant consultations with their Infantry Commanders, of constant consultation with their Colonels of Artillery, and an admirable staff of the Indian Musketry Department—unless these Generals and their subordinates have been like squirrels in a cage, for ever going round, to get no further; they ought, out of that period of experience, out of that mass of statistics, to have evolved some general principles, to have deduced some definite conclusions. I think, Sir, that the Officers of the Indian Army would not tacitly accept the indictment, that they had done nothing in that direction. I think that whilst admitting that their conclusions may be still incomplete, they would at least consent to their embodiment in the following propositions: first, that the quality of infantry fire has been found to be in inverse ratio to the numbers firing. Let me explain this quite simply. Let a company parade on its rifle range, say at 800 yards from its targets; let No. 1 section be extended, lie down and fire ten rounds per man, in any position, let the result be noted; let No. 2 section next prolong No. 1 section, the whole fire ten rounds per man, and the result be noted; it will then be found that twice one has not made two in regard to musketry effect, and that as you increase the numbers firing, to companies, battalions, brigades, and divisions, the proportion of hits to rounds falls; but falls by a very rapidly increasing degree of declension. Simple as this is, it may be sometimes overlooked in the desire to derive quality from quantity of fire. Secondly, I think it might be affirmed that the best effect of the Henry-Martini lies between ranges of 900 and 600 yards. This of course requires qualification. It must be qualified by the pre-supposition that the shorter ranges have been reached by rapid advances, and that this gain of distance has been more than counterbalanced by loss of breath and other physical disabilities, which impair the accuracy of a delicate weapon. I have here a return of the last experiment that I witnessed in India, and I think you will agree that it more than corroborates what I have said. It was a skirmishing match between the 2nd Battalion, 60th Rifles, for a regimental prize. The conditions drawn up regimentally were as follows: Ten men per

company to be picked by the Rifle Club Committee, targets 12 feet by 6 feet, advances to be by rushes of 50 yards, from 1,200 up to 500 yards, one round per man to be fired at 1,200 and one round after each rush. I would curtail these details as much as possible, by giving you only the score for the best company—No. F Company. Its ten representatives fired a total of 150 rounds, from 1,200 up to 500 yards. Of those 150 rounds, 86 were hits upon a target, 12 feet by 6 feet. I have here also the analysis of the scores, which is curious, at each successive stage. To save time I will only take the best scores. Ten skirmishers out of 10 rounds made at 1,150 yards 7 hits. At 900 yards 7 hits, at 800 yards 8 hits, at 750 yards 8 hits, at 550 yards 8 hits, at 500 yards 7 hits. It is remarkable that the score at 1,150 yards was the same as at 500 yards. The percentage throughout the whole Companies reached the high figure of 43·23, about twelve times greater than the Khoolub experiments when two Divisions simultaneously fired with the Snider at very much shorter ranges and at much larger targets. Lieutenant Hope, Musketry Instructor, who signed the report, remarks: "The best shooting was between 1,100 "and 700 yards."

These results so far support my propositions, to which I would add the corollary, that a battalion firing at 1,000 yards, from a stationary position, would still more in war, make better practice than the same battalion if it advanced firing from 1,000 up to 500 yards. It has also been found by Indian experiments that unaimed fire bears a proportion of about 2 per cent. By "unaimed fire," of course, I mean hits upon targets that were directly sheltered, and therefore must have been the result of vertical incidence. It is probable that this average would be very much higher on service, because the targets and the screens used in these experiments never adequately represented the living supports and reserves for which they were the substitute. With regard to unaimed fire—everything is fair in musketry—I will borrow an extract from some very valuable papers that Lieutenant James, R.E., has collated upon musketry instruction and long range infantry fire, in Austria, France, and Prussia.[1] "Recent experiments in "Russia have shown that at even 3,000 yards, 8 per cent. of the bullets "from a Berdan rifle fall within a space of 30 paces by 30 paces." Now these propositions, if they be true, and it is in that belief that I submit them to your better judgment, bring us I think to the verge of considerable tactical modifications, the more so if it be further conceded, that we must adapt our fire tactics to our rifle, and not cripple a new weapon by an old rule. But before we can settle this question, we have a difficult preliminary problem to determine—we have to determine not so much what is the peace performance of the Henry-Martini, but from that peace performance, we have to form reasonable conjectures as to what will be its probable war power. It is said that every army is the reflection of the nation from which it is drawn; if so, upon this, as upon any other military question, we may expect even in our own military circles some variety of military opinion. There may be critics who assert that peace experiments are altogether worth-

[1] See Journal, vol. xxii, No. 97, p. 891 *et seq.*—ED.

less, that innocuous dummies bear no semblance whatever to a malignant enemy, that motionless earthenware, to which in the course of Indian experiments I shall have to refer under the name of "chatties," can teach the English soldier nothing as to the realities of war. I am inclined to dissent from that argument, whilst I am perfectly prepared to admit that peace data must be heavily discounted by a liberal margin for all those causes, physical and moral, which may be comprised in the single expression "perturbations of war." But I would observe that if the indispensable knowledge of our weapon is to be limited to the crucial test of war, not only will that knowledge be very limited, but that it will also be in some cases very unreliable. I know nothing more capricious than episodes of war.

You may read for instance in the American War, how, near Haggerstown, a Federal cavalry regiment charged a battalion of Southern infantry; how the infantry reserved their fire, and yet how, by the delivery of that fire, not a single horse was rolled over, nor a single saddle emptied. I presume that no one, except perhaps in a spirit of military banter, would construct upon that single instance and singular incident a general theory that cavalry may attack breech-loaders with impunity.

We are more familiar with that splendid exploit of the German cavalry, when Bredow's squadrons were ordered, at all risks and at any self-sacrifice, to hold in check the 6th Corps of the French army, then intact in its formation, until German reinforcements could come up. We know how those squadrons galloped through the skirmishers, penetrated the supports, and ultimately engaged the heads of column of the main line, with a loss to themselves of only one-third of their number; yet I presume that nobody would hold up that precedent to reckless imitation, unless under circumstances of exactly analogous necessity; and even then I doubt very much—so great has been the improvement in the use of modern weapons—whether it would ever be again attended with the same success.

Examples of this sort might be multiplied, but there is no time, nor is there any necessity to do so, to establish the argument that in a great measure we must turn to peace data for our knowledge. It may be said that these peace data are uncertain, that they are chanceful. Granted, that they be so, it is still worth our while to tabulate those chances. It is well worth our while, in those respects in which the game of war has some affinities to the game of hazard, to calculate the mathematical combination of the throws of the dice. It may be rejoined that the dice are not all alike, that they are not marked by the same number of pips, in short, that targets differ widely in different places. I am dealing with Indian targets—what is their showing? They show that the practical gunnery of the artillery in India is considerably below the standard of our Okehampton experiments, and that the shooting of the infantry in India is probably better than the shooting of the infantry at home. And, indeed, it would be a reproach to the Indian Army if the latter were not the case, for that army possesses, in very many respects, great advantages. It enjoys a climate that for 10 months of the year is monotonous in

its splendour; a climate so considerate that even storms and rains observe the etiquette of fixed seasons, so as not to interfere with musketry practice; a country where a rifle range is contiguous to every barrack, and where the soldier's rifle is more often his plaything than his weapon. I have known a single battalion, in a single season, expend 36,000 rounds of Henry-Martini ammunition, at its own cost, and for its private use. Then there are prizes by the Viceroy, there are prizes by the Commander-in-Chief, there are Rifle Clubs, and Rifle Associations, collecting large sums of money, sufficient to attract a large concourse of competitors, and the time when those matches are coming off may be prognosticated by an increased demand for temperance tickets. It may perhaps be said that I am arguing against myself; that I am proving that Indian data, both in regard to artillery and to infantry practice, are inapplicable to the army at home. I admit the cogency of the objection; I will answer it as best I can—I will answer it suggestively. We have all been taught that the principles of tactics are unchangeable, though they themselves be subject to constant and considerable modifications. May it not also be true that the principles of fire are also immutable, uninfluenced even by so important a criterion as the relative figure of merit of this or that battalion? Whether a battalion shoots well, or whether a battalion shoots badly, will not alter the fact that the quality of its fire will remain in inverse ratio to the numbers firing. Whether it shoot well or badly will not alter the fact that it will always shoot better from a fixed firing-base than from a moving one, albeit the moving one brings it to some shorter ranges; in short, that the artillery axiom, not to move guns, well in action, may now, for best effect of long-range fire, be extended, to the extended range of the Martini. These suggestions may perhaps prove serviceable in the simplicity of their application—they are certainly exempt from any dangerous merit of originality, for they are self-evident. It is evident that few skirmishers will shoot better than many skirmishers, because the few skirmishers will have freer choice of ground, both for cover and for aim, thereby combining the double advantage of minimum of exposure with maximum of effect. It is self-evident that a long line of moving skirmishers can neither advance quickly, nor can it fire well. It cannot advance quickly, because a single brigade—and what is a single brigade?—on war footing, expands a fire line of some 800 yards. After that expansion, any individual divergence is strictly prohibited. Now, to maintain the true direction; to maintain the precise intervals of so long an alignment, even for a short distance, is high tension drill. I have tried it in India; bad ground renders it impossible; the best ground makes it slow. Such a formation can never advance at a greater rate than two miles an hour. Two miles an hour, across the zone of greatest danger! But I have added also, it cannot fire well. It cannot counter-fire, because small inequalities of ground, such as may be met with in Hyde Park, will multiply themselves constantly along the direction of its hampered advance, and thus blind an incredibly large proportion of its rifles. This is a detail, but one which in India has received some attention. When the eye of the skirmisher is close to the level of the

ground, an intervening mole-hill may become a mountain, to screen a distant parapet of considerable relief. Now, if we fix the range of the Henry-Martini, theoretically, at 2,000 yards (the Rifle Brigade are now conducting target practice in India at 2,000 yards), 2,000 yards may also be the distance of the advance. In that distance, the heavily-weighted infantry of the attack, say what you will, must lie down. They must lie down for fire, they must lie down for cover, they must lie down for breath. Breathless haste may for a time avoid punishment, steady fire alone can inflict it. Speed of movement and steadiness of aim are irreconcilable. If you attempt to combine both, it will be to the sacrifice of both; and as you cannot dispense with either, I see nothing for it but to use them separately, by assigning distinct functions to separate troops, some to prepare the advance, some to cover its nearer approach, and some to reach the ultimate goal.

Again, if the advantage of a fixed fire-base over a moving fire-base is to be tested, let it be tested by a battalion in marching order. When the 60th Rifles left my division for Mooltan, I weighed the articles of their field equipment. These men, in addition to their rifle, their sword-bayonet, and 70 rounds of ammunition, carried nothing but their great-coats; and yet the aggregate weight of these articles, accoutrements included, was something like 42 lbs. Now 42 lbs., if men are to double and to shoot for 2,000 yards, is a steadier. I use the word rather in a cavalry than in a musketry sense; and such weight becomes absolutely prohibitive in those difficult turning movements which are the characteristic of mountain warfare. But behind this question of distance and of weight there lies another question—the exhaustion of the ammunition as well as the exhaustion of the man. Is it possible that the ammunition will last over so long and so heavy a course, if the original skirmishers, as is their peace practice, take up the running, and cut out the work from starting post to finish? These considerations point, I venture to think, to inevitable changes; but they are changes rather of tactical expediency that will promote the most deliberate fire, than of drill details. Little changes in drill are always vexatious, seldom profitable. They serve rather to confuse and to distract than to simplify and assimilate. Drill, after all, is but an Elementary Grammar of tactics, a means to an end; the mechanical functions by which troops pass from one position to another, not the study of the causes which govern and inspire their suitable application. Those causes, as they now present themselves to our attention, are imperative in their demands: they are the demands of modern fire. They have been acknowledged by the Continental armies; they have been admitted by the revised editions of our own drill books; and they consist in two requirements, as simple in theory as they are critical in execution, and therefore needing constant practice, viz., expansion for fire, contraction for shock. It seems to me that for these requirements echelon formations, always strong ones, are now indispensable. I will venture to suggest that the echelon is the key of the door of our tactical necessities—independence of Squadron and Company leadership are the hinges, whilst the deep column and the old line are its rusted bolts, but yet obstructive bar. Perhaps this simile

may sound too sweeping; but I have here a book known to all of you, Major Helvig's "Tactical Examples." It was translated by an Officer of the Adjutant-General's staff at Simla, and semi-officially issued, to the divisions. I may therefore conclude its teachings to be sound, and here I would make a passing remark. If so, it would be extremely desirable that such books should not only be translated, but that they should be transposed into such terms as would render them intelligible to non-commissioned officers and men. It is but a partial use to educate your Officers unless your rank and file share in that tactical instruction. You must attune the instrument to the agency of direction; and as between the three arms of the service there should be intimate and cordial operation, so between fellow-combatants of the same arm there should be mutual reliance engendered by constant intercourse on professional subjects. If that intercourse is patient on the part of the Officers, it will be respectful on the part of the men. But if I turn over these diagrams of Major Helvig's Tactical Examples I can find no single instance of the old line—I see lines with intervals; lines irregularly reinforced and backed up by supports; lines full of crotchets; but these unsightly zigzags bear no resemblance whatever to the symmetry of our parade movements. It would puzzle an Adjutant of the Guards to transform his parade line into one of these figures; yet if these figures represent exemplary formations, I would suggest that an irregular echelon of Company columns analogous to the squadron column of troops, would at once conduce to any of them.

But I must leave this subject to refer to the drier subject of the Meerut experiments. I should not refer to them exclusively but for the fact that the experiments of 1878 were not, as usual, published by Head-quarters. That they were satisfactory and that they were progressive would appear from the following letter of the Adjutant-General:—"I am desired by his Excellency the Commander-in-Chief "to acknowledge the Field-firing Reports, from different stations "under your command, in which the subject of Tactical changes, both "offensive and defensive, which the range and penetration of the "small-bore Rifle has made a necessary subject of consideration, is so "fully discussed, and to inform you that it will receive that attention "which the importance of the matter demands.

"The question how the great power of the Martini can be best "developed and employed has received, as its importance demands, "attention in All Commands, and the interest taken by General and "other Officers of great military experience has resulted in many "suggestions for the more instructive conduct of this important "practice."

This letter seems to me to admit the necessity of impending changes; or rather, the necessity for their consideration. It endorses in a great measure the remarks of my official report in 1878; but I would wish to quote Colonel Gordon in those suggestions which were issued by him as Chief Inspector of Musketry for the future guidance of divisional practice. "Colonel Gordon, Chief Inspector of Musketry, "in his unofficial summary of these and former experiments, and

"more particularly in view to the issue of the Henry-Martini to the "English Infantry, suggests that the science governing artillery prac- "tice should, in a lesser degree, be applied to that of the improved "rifle; that the men should be trained to deliver a more convergent "fire, and be practised at longer ranges than yet contemplated, in "annoying and disabling hostile artillery, though it be sheltered by "earthworks from direct fire." Perhaps it may seem that this pro- posal to apply the science of artillery to infantry practice is somewhat ambitious. I do not think it is so, so much as would appear at first, for both infantry and cavalry in India take very kindly to battery training; and I have heard artillery Officers readily admit that a good infantry soldier, especially if he were a good marksman, might rapidly be converted into a good gunner; in short, that there is, as between the rifle and the gun, much of the analogy that exists between painting and sculpture. With regard to the cavalry, I should wish to mention that the 10th Hussars in their regimental field days were almost always accompanied by a division of guns, horsed, harnessed, and excellently worked by themselves. I have quoted Colonel Gordon, and I may now quote my own remarks made in 1877, which were developed on those lines. I say, "It is an established fact, that the "containing power of infantry has and may yet further increase by "the increased range of its arms; but the problem of its adequate use "is complicated by the opposite demands of a maximum of fire, and "a minimum of exposure, and yet, of reserves sufficiently solid and in "hand, to act on shaken points, as columns of assault; in short, "the defensive-offensive deployment of an advanced guard as an "auxiliary to the preliminary artillery action, would solve many "difficulties, if it could be depended upon to hold its ground, plying "the enemy with effective fire, until its reserves, moving up, push the "issue to closer quarters. Such a force of auxiliary rifles might at "first be advanced to within 1,200 or 1,000 yards of the enemy; a "judicious dispersion would exempt it from heavy loss; its front and "flanks would be protected by the cross-fire of its more retired "artillery; the present impossibility of replenishing the ammunition "of a moving fire-line, or of relieving it, would vanish with the ex- "pedient of a more or less stationary base, for a patient delivery of "lead into the perimeter of the defence; and should the enemy "attempt to force its thin line, such counter-stroke must bring denser "formations under the deliberate fire of an overlapping curtain, which, "if obliged to yield, would fall back upon its supports. Small groups "of marksmen, detached from this general cordon, might use cover "for closer approach to the position, understanding that the object of "their employment was to harass the enemy, without too far com- "promising themselves."

My official report of 1878 closely corresponds with this. I say: "The "Field-firing with the Henry-Martini, at its longer ranges, claims "attention. Such a figure of distant effect, if attainable on service, "points to tactical changes, greater than any yet contemplated. The "present rifle has only been once tested in war, and then placed in the "hand of the half-trained Turk, has given us no full measure of its

" deadliness, yet sufficient (so it is said) to have convinced General " Skobeleff, after Plevna experiences, that defended by it, no earth- " works could be stormed, unless dispositions, determined towards " sunset, were matured by a night of active counter-trenching. He " adds, that the field batteries, which, following German precept, he " with great difficulty brought into position, to enfilade, during assault, " the ditches of the place, were immediately overpowered by murderous " musketry from the banquette of the counterscarp. Reference to " Report No. 1 of Meerut Experiments gives an idea of what such loss " might be. Its object was to compare, at the same range of 1,200 yards, " and in the same time, the effect of Field Artillery and Infantry fire, " upon similar targets 18 by 6 feet."

For this purpose, a field battery of muzzle-loaders opened fire upon the target at 1,200 yards. It fired three rounds per gun, 18 rounds in all. Its time of fire was three minutes and nine seconds. After this, 56 men, unselected, of the 60th Rifles, fired upon an exactly similar target at an exactly similar distance for an exactly similar time. Their hits upon that target were 155. I remark with regard to infantry practice, that "a brisk wind across the range was most " against the rifle," as unprovided with any scale for deflection, and also that "a company support in line would present a seven times " wider mark" than this target, "how then, under such fire, in the " open, could any order of attack consistently advance?"

With regard to the artillery, I remark that the guns were well laid, but the result, from defective ammunition, accidentally below the standard of battery practice. It therefore may be dismissed as worthless as a comparative test; not, however, worthless as showing the extreme liability of artillery to loss of accuracy by defects of ammunition. These defects are very seriously prevalent in India, as may be seen by a Report I have here from a Colonel of Artillery on the subject. He remarks that the Range Tables, compiled at Shoeburyness, are thrown out, by practical experiment, in that climate, and a more liberal allowance needed for good gunnery. I understand that the Commander-in-Chief has ordered that 30 additional rounds should be fired at the annual inspection of every battery in India.

I find that the appointed time for the lecture has been exceeded. I therefore can only add, that I think it would be perfectly possible to combine the best kind of long-range rifle fire with the preliminary action of artillery. What I imagine is most required now, unless the attack is to be overmastered by the defence, is a preponderance of counterfire. To establish such preponderance of counterfire, companies backed by their supports might, when possible, be brought like batteries into distant action, exposing no greater number of rifles than can be effectively employed, and patiently maintain them in favourable position by re-supply of ammunition. Such fire, although insufficient for its professed purpose, would at least assist, whilst it could guard the supporting artillery, upon which the Germans, in 1870, solely depended for their infantry attack. I can, however, find no instance of this ever having been fully accomplished, or any of our own artillery Officers, although I have frequently consulted them on the subject, who would undertake to pro-

nounce such a result without ascertaining it by a partial engagement of infantry. (We have only to turn to the campaign in Asia Minor to know that guns apparently silenced sometimes revive when the attack of the infantry commences.) Such engagement of infantry would of itself derange and upset the symmetry of any too exact order of battle, and herein lies another of many reasons for thinking that an attack at once wholly compromised, would be more hazardous than the detail of certain troops to cover the advance of separate reserves; such covering force being safe against any distantly organized counter-attack, which could only be attempted against the Martini with heavy loss, and at best, with undecided success. Of course there is no time to submit such a suggestion in detail at present. I think one of the most important points for its satisfactory solution would be that it should be carried out in consultation with Officers of Engineers and of Artillery. Of course those details of the infantry action would vary according to the original disposal of the artillery, whether it were massed for concentration, or whether under certain circumstances, peculiarly favourable, the batteries could be more widely distributed, without losing their power of convergent fire upon common objects, for decisive effects.

And now, Sir, I will no longer delay the more profitable part of the day's proceedings, viz., the discussion, which this introduction may provoke. I beg only to thank you for the patience with which you have heard me.

The CHAIRMAN: The subject that General Hardinge has brought to our notice, namely that of infantry fire, whether at long or short range, is perhaps the most important one that military men have to consider; we are, therefore, much obliged to him for the way in which he has brought it before us. There must be many gentlemen here who have been glad to hear the lecture, and I hope that they will give us their opinions (practical as well as theoretical), as to the effects they have seen produced by the fire of the long-range breechloading rifle, the infantry arm of the present day.

[No Officer rising, the Chairman continued]: The disinclination to enter into any discussion on the subject arises very probably by our being taken somewhat by surprise by a lecture which requires great consideration. The changes that have been made are so great with regard to the power of fire that we must look to the facts of practice to guide us for the hereafter of our Infantry. I do not myself wish to enter into the discussion; but I should have been glad if some gentlemen who have been lately on service and have seen the great effect of breechloaders, had given us their opinions, and thus disseminated that information which is so valuable in this Institution. Without saying anything about the artillery, the cavalry, or the engineering of the present day, there is no doubt that in times past and up to the present, the infantry has been the decisive arm that has gained battles. Therefore it is that the fire of the infantry becomes so important for us to consider, and I express a hope that hereafter when this lecture has been published we shall have another opportunity of discussing it. I am quite sure I may return the thanks of this meeting to General Hardinge for the way in which he has brought this subject before it.

GENERAL HARDINGE: As discussion will not for the present take place, with the Chairman's permission, I will, on account of its importance, add the particulars of an experiment, which want of time led me to omit. It was to test the present formation of attack, as laid down before the issue of the Martini.

Three hundred men, two companies of the 60th, and two companies of the 39th N. I., defended two small redoubts against a dummy brigade of three battalions, disposed exactly in the authorised formation; only a small proportion of the low dummies was visible to the defenders.

The skirmishers	chatties 18 inches ..	at 400.
Supports	2 feet high	at 600.
Half battalion (screens spread flatly) ..	..	at 900.
Brigade reserve (in column) of 6 ft. screens ..		at 1,700.

Of 1,440 of the enemy, thus represented, 741 were hit, by less than 20 rounds per rifle, in about ten minutes.

General percentage	12·02.
148 Martini hits upon the reserve—	
Percentage of Martini	16·02.
Percentage of Snider	7·50.

Such havoc impressed all present with the conviction that the problem of offensive counter-fire has yet to be worked out.